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ABSTRACT

Under the sponsorship of the Engineering Foundation and the co-sponsorship of the Society of Women Engineers, a conference on "Women in Engineering--Bridging the Gap between Technology and Society" was held. The conference's goal was to consider the extent to which a greater participation of women in technology can arrest the widening gap developing between technology and society and to propose a national strategy for increasing this participation. This document contains the addresses of invited speakers concerning various aspects of the problem as well as background information. The main thrust of the conference was carried out through action-oriented workshops. Workshop I addressed the problem of the gap between technology and society and the role of women in reducing it, and Workshop II considered women as engineers and their opportunities. These two workshops served as background primers. Workshops III, IV, and V considered programs for the effective participation of women engineers in industry, government, and education, respectively. A sixth workshop pursued the philosophical aspects of the problem being considered. In the summary an outline is given of workshop activities, including recommendations and resolutions. A selective bibliography and a post-conference newsletter are presented in the appendices. (Author/PG)

WOMEN IN ENGINEERING

BRIDGING THE GAP BETWEEN SOCIETY AND TECHNOLOGY

EDITED BY

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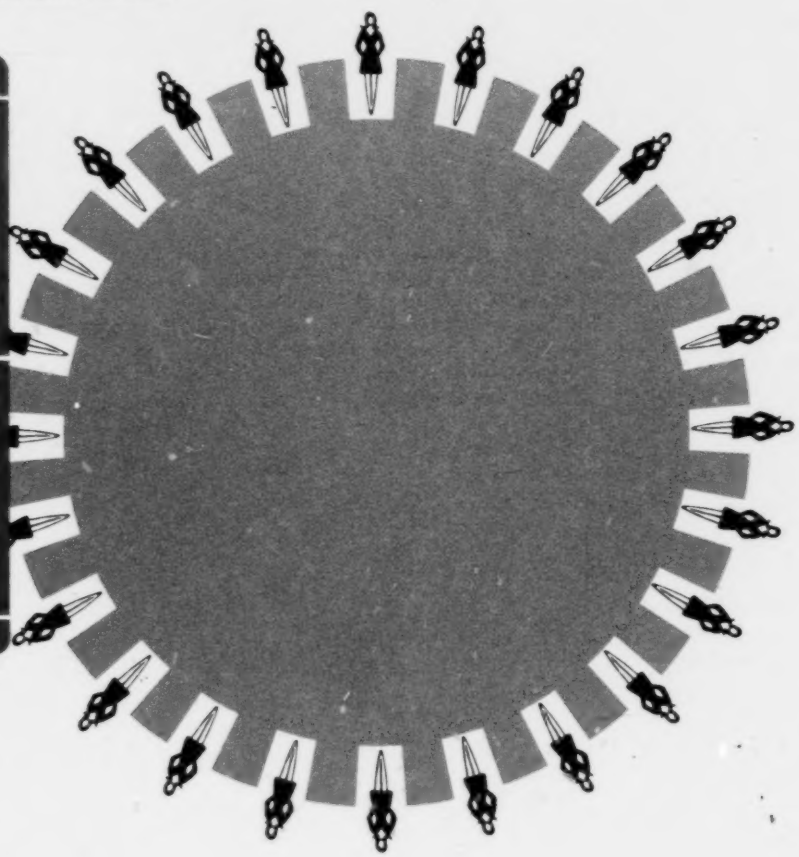

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PROCEEDINGS OF AN ENGINEERING FOUNDATION CONFERENCE

JULY 12-16, 1971
NEW ENGLAND COLLEGE
HENNIKER, NEW HAMPSHIRE

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WOMEN IN ENGINEERING

Bridging the Gap Between Society and Technology

Edited By

George Bugliarello
and
Vivian Cardwell

College of Engineering
University of Illinois at
Chicago Circle

Olive Salembier
and
Winifred White

Society of Women Engineers

Proceedings of an Engineering Foundation Conference

July 12-16, 1971
New England College
Henniker, New Hampshire

Women In Engineering

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Engineering Foundation Conference

WOMEN IN ENGINEERING

Bridging the Gap Between Technology and Society

Conference Chairman

George Bugliarello, Dean
College of Engineering
University of Illinois at Chicago Circle

Conference Co-Chairman

Olive Salembier, President
Society of Women Engineers

Conference Steering Committee

Stanley W. Burriss . . . . . .President, Lockheed Missiles and Space Company
The Honorable Martha W. Griffiths . . . . . Member of Congress
Charles F. Horne . . . . . Chairman of the Board, Southern California Industry Education Council
Robert S. Ingersoll . . . . . .Chairman of the Board, Borg-Warner Corporation
David R. Reyes-Guerra . . . . . Executive Director, Engineers' Council for Professional Development
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The Conference

Under the sponsorship of the Engineering Foundation and the co-sponsorship of the Society of Women Engineers, a conference on "Women in Engineering—Bridging the Gap Between Technology and Society" was held at New England College, Henniker, New Hampshire, July 12-16, 1971.

The Conference gathered a small, selected group of engineers—both women and men—as well as industrialists, economists, educators and government personnel, who were willing to spend a week of hard work in the monastic isolation of the quarters provided by the New England College at Henniker. The goal was to consider the extent to which a greater participation of women in technology can arrest the widening gap that is developing between technology and society and to propose a national strategy for increasing this participation.

Invited speakers addressed themselves to various aspects of the problem and provided background information, while the main thrust of the Conference was through action-oriented workshops which were loosely structured to allow freedom to the participants to contribute to the defining of the workshop tasks.

Workshop I, which addressed the problem of the gap between technology and society and the role of women in reducing it, and Workshop II, which considered women as engineers and their opportunities, served as background workshops, each one attended by half the Conference attendees. These were followed by Workshops III, IV and V which ran concurrently and considered programs for the effective participation of women engineers in industry, government and education, respectively. A sixth workshop was formed after Workshop III had completed its task, because a need was felt to pursue further some of the general, philosophical aspects of the problem being considered. A seventh was concerned with coordinating the work of the separate workshops. Workshop summary reports and recommended resolutions were presented to the Conference on the last day. All but one of the resolutions were passed.

The difficult task which the Conference had set itself was approached courageously with gratifying results. On the whole the Conference objectives were accomplished. The Conference also generated an enthusiastic personal commitment on the part of all in attendance to take individual actions in bringing about more understanding of technology within our society and greater encouragement to women to contribute their talents to the field of engineering.[1] Finally, the Conference identified problem areas that must be explored further, organizations for the carrying forward of positive programs for action, and the topics for additional exploratory conferences.[2]

The Proceedings

The Conference was committed from the time of its organization to publishing its results and disseminating them as widely as possible in a vigorous effort to implement its proposals on a national scale. This volume thus resulted.

The Conference talks are presented first, followed by the workshop outlines submitted by the workshop chairmen. These outlines contain the salient points covered during the workshop discussions and the recommendations, which constitute in essence the strategy for future action that emerged from the Conference. Also contained in the outlines are the resolutions proposed by the workshops and passed by the Conference.

[1]For a report of the Conference attendees' activities during the first six months following the Conference, see the *Newsletter* in Appendix A.

[2]A follow-up conference sponsored by the Engineering Foundation has been planned for July 16-21, 1972 and will be devoted to "Women in Engineering and Management".

It is our hope that the information and recommendations contained in these *Proceedings* will serve as a source of information and guidance to organizations and individuals from all sectors of the nation for increased understanding of the issues addressed by the Conference and for plans for action that will reasonably and effectively deal with the problems that were considered.

Acknowledgments

The idea of the Conference started in 1970 at the College of Engineering of the University of Illinois at Chicago Circle and evolved in meetings between members of the Chicago Section of the Society of Women Engineers and students, faculty and administration members of the College—Vivian Cardwell, William DeFotis, Barbara Fox, Marian Gleason, Theresa Horton, Nancy Nihan, Niva Oghigian, Eileen Woods, Patricia Ann Zeman, myself—and also Grace Wilson from the University of Illinois at Urbana. Eventually these meetings led to the involvement of the Society of Women Engineers at the national level, when Mrs. Olive Salembier, the dynamic President of the Society, agreed to become Co-Chairman of the Conference and took a major role in the planning, execution and follow-up of the Conference and in the transcription and first editing of the session tapes.

From the early stages both the idea and the planning of the Conference had the strong encouragement and support of the Honorable Martha W. Griffiths, Congresswoman from Michigan. Much advice and assistance came from a distinguished Steering Committee which, with Mrs. Griffiths and Mrs. Salembier, included Stanley W. Burriss, President of Lockheed Missiles and Space Company, Charles F. Horne, Chairman of the Board of the Southern California Industry Education Council, Robert S. Ingersoll, then Chairman of the Board of Borg-Warner Corporation and now United States Ambassador to Japan, David Reyes-Guerra, Executive Secretary of the Engineers' Council for Professional Development, and Morgan Sparks, Vice President of Bell Laboratories.

The sponsorship of the Engineering Foundation and the dedicated and efficient support of Dr. Sandford Cole, Director of the Engineering Foundation Research Conferences, made it possible to translate the plans for the Conference into operating reality. President Jere Chase, the administration and the staff of New England College—an exciting newcomer to the fold of the New England colleges—contributed substantially to the smooth conduct of the Conference and provided warm and impeccable hospitality.

Dr. John Parrish, Professor of Economics at the University of Illinois at Urbana-Champaign provided invaluable ideas and background material for the Conference.

To the task of editing the *Proceedings*, Mrs. Winifred White, Executive Secretary of the Society of Women Engineers, contributed her skills, patience and unfailing goodwill.

But above all, it was the enthusiasm of Vivian Cardwell of the administration of the College of Engineering at Chicago Circle, her diplomatic tact and her hard work way beyond the call of duty that made the Conference possible and the *Proceedings* a reality.

Publication of the *Proceedings* has been made possible by the support of the Engineering Foundation, American Telephone and Telegraph Company, General Electric Company, General Motors Corporation, and the College of Engineering of the University of Illinois at Chicago Circle.

George Bugliarello
Conference Chairman

Women, Technology and Society

George Bugliarello, Dean
College of Engineering
University of Illinois at Chicago Circle

At a moment when our society is undergoing a crisis of conscience and direction, it is vital to reconsider the issue of the participation of women in engineering and technology. Two crucial elements of the crisis are the reappraisal of the role of technology and the assertion of the rights of the minorities and the under-represented. Thus, participation of women in technology involves both the "matter of simple justice"[1] and the vision of our society's future.

We know that in this country engineering has been a profession largely alien to women. Of course, there are exceptions, but they only serve to highlight the incongruity of the fact that only 1 percent of all engineers in the United States are women. The same proportion holds in West Germany and other western nations. It may be revealing to note that a recent and very detailed survey of the engineering profession in West Germany, undertaken by the magazine, "Der Spiegel", "for methodological reasons . . . had to exclude from the inquiry the 3600 women with professional engineering qualifications."[2]

We know that there are prejudices. These are the usual prejudices against career women in general. They lead to the bypassing of a woman for management training or other career opportunities because "she is going to get married"—possibly a rationalization, unwarranted as it may be by the facts, of a deeper attitude of *homo* manager or *homo* professional toward women. There are also the specific prejudices that stem from obsolete views of engineering and of the physiological capabilities and psychological attitudes of women.

We know that we have made no adjustment to make careers in engineering, or in many other professions, easier for women, on whom our present social structure places the greatest portion of the physical burden of raising families. And yet we also know that both our technology and the nature of engineering work today are releasing us from many of the spatial and temporal servitudes to which we have been inexorably subject until recently. Adoption of new patterns of work and organization is increasingly a matter of will and attitudes.

We already know many of these factors, and in this Conference we shall investigate them in greater depth. But what we, as a society, have failed to do, is to draw from them the inescapable conclusions—and to act guided by these conclusions. Essentially we have failed to perceive the deep societal implications of a technology as an activity that, for whatever reason, is carried on for all practical purposes to the exclusion of women. (And when we speak of technology, we should consider it in a broad sense—engineering for sure, but also the other professions in which organization combines with specialized know-how for the delivery of services. This includes law or medicine or architecture, where the ratio of women to men, although numerically more favorable than the 1 percent in engineering, is still extremely low.)

If we accept the obvious premise that technology, intended in this broad sense, has exerted the deepest influence on our society, and if we accept the premise, as I believe we must, that, while we can point our future toward many directions, and we still have some freedom to do so, each of these directions will

[1] "A Matter of Simple Justice," The report of the President's Task Force on Women's Rights and Responsibilities, April, 1970.

[2] *Der Spiegel* "Professions of our Readers. 2) Engineers," 1971.

involve technology and will largely be made possible by technology, then we must ask ourselves:

How can we achieve the promise of our future if technology is viewed and is conducted as the activity of only a segment, a sexually segregated segment, of society?

How can we achieve this, if our school teachers, those who to such a large extent exert such a major influence in shaping the future of our society and most of whom are women, view technology as alien to them and inevitably convey this attitude to their pupils?

How can we achieve this if women, with the tremendous influence they wield as voters in making political decisions—and therefore decisions about technology, from the SST to urban mass transit—view technology with indifference or not as "their thing" because they only use it, or criticize it, but do not participate in its making? (Is it not appropriate to remind ourselves, at this point, that in Soviet society 30 percent of all engineers are women?)

Even more importantly, if technology has acquired the kind of pervasive influence in our lives that religion had in the Middle Ages—and there is strong evidence that in many senses it has—will we not inevitably have in our technology a terribly oppressive force, impersonal and insensitive, if men and women fail to become jointly involved in it, to put jointly their shoulders to it, to nurture it jointly? Because only if they do so, can technology reach the universality it needs to truly serve society.

These are the issues that the majority of our industries, our government and our schools of engineering seem to have perceived only imperfectly and that need to be better defined and translated into plans for concerted national action.

The question before us at this Conference is therefore a two-fold one:

In the first place, can we more clearly identify and analyze the elements of the gap between women and technology—and, therefore, between society and technology?

In the second place, can we evolve a national plan to bridge this gap through a greater involvement of women as engineers in industry, in the government, in education?

George Bugliarello

George Bugliarello holds an engineering degree from the University of Padua, an M.S. from the University of Minnesota and a Sc.D. from Massachusetts Institute of Technology (1959).

In 1959, he went to teach at Carnegie-Mellon University where, in 1964, he became Chairman of the Biotechnology Program and, in 1966, Professor of Biotechnology and Civil Engineering. Since September 1969, he has been Dean of the College of Engineering at the University of Illinois at Chicago Circle.

In 1967, he received the Huber Research Prize of the American Society of Civil Engineers. In 1968, he was State Department Specialist in Venezuela and, later that year, a NATO Senior Post-Doctoral Fellow at the Technical University of Berlin.

He has authored over 100 publications in the areas of bioengineering, fluid mechanics, computer languages and social technology and is editor of the book *Bioengineering—An Engineering View.*

He is currently Chairman of the American Society of Civil Engineers' Engineering Mechanics Division Executive Committee, a Director of the

Biomedical Engineering Society, Chairman of the Committee on Educational Systems of the Commission on Education of the National Academy of Engineering, Chairman of the Advisory Committee on Technological Innovation and Monitoring of the National Academy of Sciences, editor of *Biorheology* and on the editorial boards of the *American Journal of Cybernetics, Environmental Letters, Biomedical Engineering Journal, Journal of Hydraulic Research, Journal of Educational Technology Systems,* and *Fluid Mechanics - Soviet Research.*

Women Engineers

Oliver Salembier
National President, *Society of Women Engineers*

The Society of Women Engineers is an educational, nonprofit organization founded twenty-one years ago with the basic purposes of making known the country's need for women engineers; to encourage young women to consider an engineering education; to inform young women, their parents, counselors, and the public in general of the qualifications and achievements of women engineers and of the excellent opportunities open to them—and, hopefully, to help in bridging the gap between technology and society as it now exists.

In the relatively short years of the existence of the Society of Women Engineers we have accomplished a number of things which are noteworthy and interesting. We have created the Lillian Moller Gilbreth Scholarship given each year to a young woman engineering student. We have established the SWE Achievement Award, which is presented annually to a woman for outstanding achievement in engineering. The woman who receives this award need not be a member of the Society of Women Engineers, and since the award is not a national but truly an international honor, our choice of an Award Winner is really of significance.

The Society, in its local sections and nationally, has organized programs for students, guidance counselors and parents. We have sponsored forums, lectures and seminars on engineering education, and assisted women engineers to prepare themselves for a return to active work after temporary retirement to raise families—and, in the present day, temporary retirement due to lack of engineering employment opportunity. We also serve as an information center nationally, and internationally, to provide otherwise unattainable data in the engineering field to government, industry, educators and the general public.

One of the major things we have to deal with in attempting to provide correct information is the handling of some of the myths about engineering—and particularly about women in engineering.

One of the common myths is that engineers have to be physically rugged because they work outdoors, in mines, and on dirty assembly lines. This, of course, is not so. For men and women alike, 90 percent of the engineering jobs are done in air-conditioned offices.

Another myth which appears constantly is that mechanical aptitude is the most important trait of the aspiring engineer. This can be put away with the "engineer's cap and overalls" of days gone by. Intellectual ability and analytical minds are much more important today.

Still another myth is that engineering is too difficult. Of course almost anything is too difficult for the individual who doesn't want to try. In relation to students, however, we find this myth appearing frequently. Actually engineering is not too difficult for any student who has a normally good background in mathematics, physics, chemistry and, I like to add, English. There's not much point in knowing what you are doing if you can't communicate that thought to anyone else.

Of course, there's always the old saw that engineers do not move up the executive ladder. I think as you meet some of our speakers, and as you have already met representatives of New England College, you will realize that we have dis-proof of that in our midst. Many of the people who will speak to you during this Conference are people who started with an engineering background and have certainly climbed well up the executive ladder.

Women engineers have been getting some assistance recently in debunking

the old myths. The Department of Labor has published a pamphlet lately on the subject, and I have seen a number of articles published nationally which set out the truth quite clearly.

There are always those, however, who will not give up their old ideas. There are still those who plead with genuine conviction that the woman's place is in the home. It's nice work if you can get it, but in today's economy it doesn't always work out that way.

In reality today, half of all women between the ages of 18 and 64 are working and making a substantial contribution to the nation's economy. Studies show that 9 out of 10 girls will work outside the home at some time in their lives.

A continuing myth is that women are not serious in their work and work only for extra money. I think all of us recognize that in today's economy pin money is a thing of the past.

Another myth is that women have more days off for illness than men. This we hear very often. It is one of those things you never could quite disprove, until a public health survey really got together some statistics which showed that 5.9 days per year is the normal absence rate for women, as compared with 5.2 days per year for men.

It has been charged that women don't work as long or as regularly as men. Their training is costly and largely wasted. The reality is that, although many women leave work for marriage and children, the absence is only temporary for the majority. They return to work when their children are in school. Despite this break, the average woman worker has a work life of over 25 years, compared to 43 years for the average male. This span is continuing to break down and we are finding that women are continuing to have an increasingly longer work life. I was a bit sad when I found a little note on a recent report indicating that single women (and I suppose this goes for divorced women too) average 45 years in the labor force. It somehow sounds like a life sentence.

Perhaps engendered by some remnants of prejudicial feeling, it has been suggested that women take jobs away from men. It has also been suggested that they quit the jobs they now hold and let the men be the breadwinners. Actually if all the unemployed men were placed in jobs held by women there would be 29.3 million unfilled jobs. In addition, the majority of single women in the labor force support not only themselves, but possibly their parents, and they help educate their younger siblings.

Women, it is said, should stick to women's work and should not compete for men's jobs. This objection falls of its own weight as we legislate non-discrimination into our society.

"What in the world do women engineers do?" is a question with which all of us are sooner or later challenged. My own answer, which I think is quite just and honest, is that they do exactly what men engineers do—there is no difference whatsoever.

I think I can end the myths with this one. No matter how cleverly paced the dinner table conversation, no matter how well goes the job interview, no matter how interesting the visit with the airline passenger in the next seat, when the time comes for a women to admit she is an engineer, the next question is inevitable: "Don't you find that you have trouble getting men to work for you?"

I suppose it has been traditionally accepted that men don't like to work for women. In my personal experience I have found that men who enjoy their work get it done without any thought of whether their supervisor is a man or a woman. By the time you get all the contradictory statistics together about how many men like to work for women and how many men don't like to work for women, you come up with the simple answer that if a man wants to work, he is

going to work, whether it is for a man or for a woman.

I think it is more a question of, "Does he like to work?" than "Does he like to work for a woman?" I can specifically recall the one man, in my whole career, who refused to accept a job in my organization because he would not work for a woman. My feelings were hurt, because I was trying to be very fair in the situation. I didn't want to discriminate against men. He didn't take the job and he left. A little while later I met the head of the company who did hire the man. And do you know that although he had a man supervisor there, I found out that he didn't want to work for him either. So we were back in the same position of simply using a smoke screen.

I feel that it is quite unworthy of a man to pretend he doesn't like to work for women. After all, they do it in their private lives and I see no reason why they should be any different on the job.

So much for the myths. Now let's look at the realities. I do think it would be interesting to identify the women engineers in this group, and I would appreciate it if all of them would stand up and be counted. . . . . .

That's about half the people in the room, which makes a very nice mix. The most important thing, however, is that those of you who were not identified as women engineers will know now that you can just turn to the person next to you and find out something about women in engineering first hand. I believe that is how we are going to get the most out of our Conference. By the interchange of ideas and communication between people at our meal times and during social hours, you will get a great deal more information than you do in a more formal atmosphere.

The workshops, I hope, are well balanced so that we will have engineers and non-engineers. Most important is that those of you who are not engineers feel free to ask all of the questions you have always wanted to ask about women engineers. I really went through the "myth" business, not because it is new, but because we certainly are not embarrassed by any of these questions or by a whole lot of others you may have in the back of your mind. I doubt that there is anything that has not come up before in relation to women in engineering.

There is much to gain in exchanging information with one another. Perhaps some of the women engineers, who have been somewhat circumscribed in their own positions, are unaware of the extent to which industry and educators have widened their horizons. We cannot fail to obtain valuable results by working together in trying to bring a greater understanding between society in general and our technological approach.

The topic of this Conference, "Bridging the Gap Between Society and Technology," appealed to me from the beginning. Since the gap had developed, it seemed, fairly recently, it obviously had to be dealt with and I was sure we would work out some great plans.

But I should have remembered that there is nothing new under the sun. A few days ago I rediscovered a report of a Conference held at M.I.T. in 1964 in which one of the topics presented was entitled—would you believe it—"Closing the Gap."

The talk was given by a very, very important woman engineer—known to us in the Society of Women Engineers as the First Lady of Engineering—our very talented, brilliant, and dear Dr. Lillian Gilbreth, about whom a recent book has been written.

This book I recommend to each of you—women engineers, women-not-engineers, and to the men present. This book is an experience that you owe yourself. I am sure you remember Dr. Gilbreth as the mother in *Cheaper By the Dozen, Belles on Their Toes* and other stories about the Gilbreths, who are an exciting and interesting family. But the new book, written by her son, Frank Gilbreth, Jr., called *Time Out For Happiness* is about Dr. Gilbreth, the woman

engineer. It answers many of the questions which may come to your own mind about the problems of women in engineering. To me, personally, it is a great inspiration and I am sure that our women in engineering throughout the country feel this way. I recommend it strongly.

But to get back to Dr. Gilbreth's talk entitled "Closing The Gap," I would like to read you just a paragraph or so:

> "Let us see what our past has to tell us about closing gaps. Or more especially about finding answers to problems. From their earlier history, engineers and scientists have been concerned with problems. I am going to consider that part of their work called management. First I would like to look back into history to find out what experience in closing the gap engineering and science have to offer. It seems to me the first thing they offer us is a code of ethics. It is a very simple code. Easy to say, but not so easy to live up to. It says our job is to utilize the resources of nature and of human nature for the benefit of mankind.
>
> "Of course if we are going to utilize them we first have to know what they are and where they are. Then we must think about how to utilize them. How to take an idea that some scientist has creatively formulated and put it into useful shape. This too is a creative experience. A closing of the gap. For when we take ideas, perhaps originated by others, and work with them and organize them and put them into actual use by you and me and people in industry all over the world, we have utilized resources, both of nature and of human nature.
>
> "In the wide world today this is one of the most exciting processes of development. People of all countries as they learn more about engineering and science are discovering for themselves that they have resources they never even knew about."

I am sure that those of us today who are sitting in the beginning session of this Conference will find by the end of the week that each of us has come up with resources we never even knew existed.

Olive Salembier

Olive Salembier, National President of the Society of Women Engineers, is a Packaging Engineering Consultant in Phoenix, Arizona. Educated in Commerce and Education at the University of British Columbia, she later turned to packaging engineering. She has served as President and Chief Engineer of a packaging firm in Los Angeles and of Specialized Packaging Engineering Company of Phoenix and has taught extension courses, short courses and seminars at the University of California at Los Angeles, California State College and Arizona State University. Mrs. Salembier was the first woman elected to Sigma Pi Epsilon, honorary packaging fraternity, and the first woman to win a first prize in a National Packaging Competition of the Society of Packaging and Handling Engineers. She won another national prize in the Military Packaging Competition and has been cited by the United States Navy, the American Trucking Association, the Society of Packaging and Handling Engineers and the American Material Handling Society for her many contributions to the field of packaging engineering.

An Industry View

Stanley W. Burriss
President, *Lockheed Missiles and Space Company*

It seems worthwhile to provide, at least briefly, a backdrop for the position of industry on this subject of major concern to the attendees at this symposium.

Our view is necessarily pragmatic. We must at once take the long-range point of view as well as the short-range. Within this depth of focus we must define the problems and hopefully plot their solutions, if any, at the same time allowing for costs which must be paid and setting goals that are economically viable. All of these rather obvious elements in the industrial picture are, of course, sensitive to a number of equally obvious factors. Among these are the problems of resources and, in particular, the human resource. It is becoming increasingly apparent that the latter can no longer be taken for granted.

As engineers and scientists we are all painfully aware that in the short-term—we hope—the word "technology" has become synonymous with pollution and war. Our young people are no longer impressed with man-on-the-moon accomplishment. The fact that our problems require more and better technology has so far failed to penetrate the din of rock and roll or whatever other piper is predominant at the moment. This near-term pseudo idealism will result in a long-term problem—namely, a shortage of technologists.

The young are not alone in complicating the future. The more mature generation has improved on the rose-colored glasses complex by adding rose-colored ear plugs. The SST question has many valid arguments pro and con. Its recent defeat in Congress is alarming because the action was based on sheer ignorance. The degradation of our defenses is based on a public mood which has many roots but the taproot is the war in Vietnam. This attitude is certainly not difficult to understand. The longer-term effect is brought on by those who reason that the Communists are really not bad guys; all we need is a treaty and our only remaining problem will be an excess of plowshares and pruning hooks!

Putting all platitudes aside, the fact remains that one day, if things continue as they are, this nation is going to be faced with a crisis that will place almost unheard of demands on our technological capacity .... another sputnik, perhaps, or even another Pearl Harbor.

So, it is timely and appropriate that the Engineering Foundation and the Society of Women Engineers should sponsor this Conference at what may well be a crossroads for technology in America.

I personally believe that technology is going to survive the present attacks and go ahead with its important work. Whether we like it or not, we live today in a world beset by problems that demand solution; many of them have been postponed about as long as they will stand. And many, perhaps most of these problems, are technological in nature and probably can only be solved *by* technology.

So, if we are going to solve our problems, we are going to need more and better technology—*not* less. We are going to need more and better, not fewer, engineers and scientists. I believe our society—young and old—will come to reassess the value of technology—properly applied to the right problems—in the making of a better world.

Both the National Science Foundation and the Department of Labor predict a need for half again as many engineers in 1980 as in the peak year of 1968. Dr. Chauncey Starr, Dean of the UCLA School of Engineering, points to lower enrollments caused by today's unemployment and predicts that four to seven years from now there will be a shortage of graduating engineers.

Others point out that as members of the baby boom of the 40's and 50's become more and more affluent consumers, professional shortages of all kinds will develop—to be filled by smaller and smaller graduating classes of post-boom babies.

The last of the boom is approaching college now, and shortages of doctors, lawyers, dentists, and other professionals already are apparent and growing steadily. These professionals are drawn from the same brainy pool as the engineers, so it seems reasonable to predict a serious shortage of qualified engineers and engineering graduates by the late 70's or earlier.

I will, then, for the purposes of this discussion, assume a strong demand for new engineering graduates. This seems a reasonable assumption, but one must remember that it is there, and I feel it is a prerequisite to much of what follows.

Parenthetically, then, the extent to which we in industry can increase the employment of women in engineering may well depend upon how well we in the technological community carry out the spirit of this Conference—bridging the gap between our work and society.

And the assumption that there will be high demand—perhaps shortages—of engineers in the late 70's and beyond, brings me back to the view that industry must look positively to the employment of women. The reason is simple and pragmatic: women are the largest and most promising untapped labor pool in the nation.

Of course, there are many women workers today—almost 30 million, and more than 40 percent of all women in the country. But they are *an untapped pool* in the way that minorities (most of whom have jobs of some sort) are an untapped pool. They are underemployed, underutilized, and generally excluded from job classes where they are needed.

In fact, it seems to me that there are three classes of problems which keep business and industry from effectively tapping and using this woman-power pool:

1. Women who are in the work force are, for a variety of reasons, being underutilized.
2. Women who would like to work find that, for a variety of reasons, they can't.
3. Women who could work, and perhaps should, for a variety of reasons don't choose to do so.

To expand on the first problem, there are a number of reasons why women are underemployed. One is simply prejudice, past and present, but as most students of the problem point out, prejudice today is complicated. It usually is not the emotional or angry or stupid attitudes we think of as prejudice. It is, rather, acculturation, a calm and almost unconscious feeling of what is appropriate.

As Cynthia Fuchs Epstein points out in her book, *Woman's Place*, most occupations today are sex-typed by the society. Truck driving is a male job. Nursing is a female job and probably a man in that occupation encounters as much prejudice, from men and women alike, as a female truck driver would. Medicine is a man's profession in the United States, but seventy-five percent of Russia's physicians are women. Elementary school teaching is a woman's job; college teaching is mainly a male profession, and so on. These prejudices work both ways and women usually hold them about as strongly as men. Surveys indicate that American women generally feel more confident with male doctors and lawyers.

So prejudice can work directly to prevent a woman's getting a job she deserves, but because of prejudices—their own and that of society—women often don't try for the jobs that they are capable of getting and holding, or won't

accept promotions they are offered. They anticipate failure in "male" courses and "male" jobs and don't make the try.

You're all aware of how few women enter engineering schools and of the high percentage of dropouts. The dropout rate of all women college students is about double that of men. But girls going into "female" majors like teaching and the social sciences usually stay with their plans.

The net effect of these influences was reflected in the February issue of *Engineering Education:* That of 42,966 bachelor's degrees conferred by Engineering schools last year, only 358 were to women; of 15,548 master's degrees, only 170 were to women; and of 3,620 doctor's, just 16 were to women.

Finally, when the relatively few women graduate, studies show that a fair number never go to work, a larger number take jobs below their capability level, and, according to Alice Rossi, more than half of all employed women engineers quit work before their 44th birthday. Carolyn Perrucci, in a study last year of all the women science and engineering graduates of a large midwestern university, reported that only thirty-eight percent were currently employed.

Another reason women are underemployed in business and industry is that they sometimes simply don't want a better job with more work, or more responsibility, or more personal commitment. This again may go back to conditioning. Some women—unlike most men—simply aren't programmed to regard business success as important or fulfilling. They need a job but they don't see it as a career, or perhaps they are more comfortable with their self-image than they would be as a hard-driving tycoon.

Next, how about the woman who wants or needs to work but isn't in the labor force? She may lack skills, or mobility. She may have small children who prevent her working, or, again, she may be excluded by prejudice from the job she wants and feels qualified for.

And finally, there is the woman who perhaps *should* work, and could contribute, and would benefit by the process. Mrs. Epstein describes her: "Women in American society have not tended to view work as central to their lives, as an avenue for self-expression and stimulation .... Most middle-class women have viewed the occupational market as irrelevant, and work as supplementary and contingent. Their education is not supposed to provide them with more than enough general literacy to make them good mothers and companions—their principal rights as members of the affluent society. Thus, from those women whose education could more fruitfully be directed to careers in the wider world, few heroines have emerged. Our best women—those in whom society has invested most heavily—underperform, underachieve, and underproduce. We waste them, and they waste themselves."

Well, that's a very brief picture, but where does it leave us? What should and can industry do about employing these women and assuring them their full rights? Is it all up to business, or is it a two-way street?

First, I believe sincerely that industry should make a whole-hearted effort to employ women—engineers, we're thinking of here—on an equal basis with men, and to afford them the same opportunities for growth, for satisfying work, and for advancement.

There are several reasons why I feel this way:

1. As I said earlier, we are going to need them.
2. They can be excellent employees and they bring some special qualities to the job, such as a different point of view, and engineering can benefit from fresh viewpoints. Women have special talents for the human-relations side of management, according to Michael La Sala of Honeywell, a pioneer in the field of integrating women into management. "They're also good at detail," La Sala says. "They zero in

on fine points that make and save money." They're good team players, according to management consultant Estill Buchanan, who says that women are psychologically attuned to the new concept of business team leadership. And they even benefit by the old standby, feminine intuition. According to the August 2, 1969, issue of *Business Week*, personnel officers repeatedly cited female intuition to reporters, and a surprising number of bank officers depend on it. They say they'd rather have a woman than a man judge a borrower's reliability.

3. It is simply morally right that every one in our society has the right to be employed and advanced on his merits regardless of his color, race, religion, or sex. I believe that society is coming to believe and expect this and, as an institution of society, business should follow the same standards.
4. For most of us, it is the law, but I think you will agree with me that the other reasons are not irrelevant.

Next, ladies and gentlemen, I distinctly do not believe that the matter of hiring and promoting women in industry, as engineers or whatever, can be a one-way street. In fact, if you read some of the literature on the subject, you find such a skein of interlocking factors, cause-and-effect relationships, conditioning-breeding attitudes leading to effects which reinforce the conditioning, that you almost despair at even solving the total problem.

I am convinced that industry working alone could not do the job. I am convinced that industry must take steps, but they must be matched by changes in society and many of its institutions and they must be coupled with efforts and changes on the part of women.

Industry, certainly, has much it must do. For one thing, it must get the modern facts about absenteeism, turnover, tenure, educational and skill levels, career interests, fair performance standards, and so on. Many people in industry believe—from either outdated data, hearsay, or assumptions—much about women's performance that is not borne out by the readily available statistics.

Next, industry must establish firm policies on the employment and advancement of women, and it must emphasize these policies to its employees and to the public.

The fair-employment problem for women is much like that for minorities. It is my impression that there really hasn't been much resistance among managers to the employment of minorities, but it was easier to go along with the *status quo*, and it just wasn't going to happen until company leadership made the policies unequivocal, plain, and public. I think it will take something of the same emphasis to implement fully fair employment of women.

I think we also need to look thoughtfully at less obvious management attitudes. For example, the average good manager probably will praise a woman employee for a performance that's not quite up to what he expects of a man in the same job. A double standard of performance, which, when you think about it, does the woman no favors. On the other hand, to win a promotion to a responsible job, she probably has to outperform her male rival by a significant margin.

I think business and industry must seek ways to accommodate to women's career considerations. For example, try to work out financially viable ways to use part-time and odd-shift workers, work toward meaningful leaves of absence for capable professional employees' young-family years, and perhaps encourage local universities to provide skill-maintenance courses that will return the employee to her career after several years' leave, more technically current than if she had worked steadily at her job.

To be realistic, such plans would have to be financially feasible for the

company, but that should not deter business and industry from making the effort to develop them.

And finally, for Mrs. Epstein's wasted middle-class woman, and for our alienated youth, and even for our general public, I think we must do a better job than American industry ever has done to tell our stories of progress, of contributions to society, of the self-fulfillment of careers at productive work within an enlightened technical enterprise.

I mentioned the role of society in this task, and there are some accommodations society must make. Government is already picking up its role of law and regulation, but it can look at facilitating the process with aids like day-care centers, the repeal of discriminatory statutes, and so on.

The schools face a tremendous task—bringing up enrollment of women students in all the professional schools, looking at special programs such as the skills-maintenance courses I mentioned, even helping to eliminate job prejudice through its own policies. For example, Mrs. Epstein points out that virtually no women were admitted to the prestigious Wall Street law firms until the Harvard Law School changed its policy to admit women students.

Now, all this probably sounds pretty progressive and Pollyannish up to this point, as it should because it outlines the way a fair-minded company should respond to established public policy—*given certain conditions*—and most of those conditions are up to the women employees.

I mentioned at the beginning of my discussion that I must talk about costs, and the things I have been discussing are costly. As a representative of industry, I must point out that a company can bear, over a period of time, only those costs that bring in at least equal value. There is no way to get around it.

And if these efforts and the related costs are to give full, or even nearly full, value, then there are some things the women must do, too:

1. They must change their own attitudes—their prejudices, if you will—in many cases against themselves. They must patch up their success-images of themselves. Women as a group turn down many chances at special training and many offers of promotion, which men seldom do. And when a company thinks you are ready for promotion, that means it wants to benefit by more of your potential. Consistently resist the offers and requests and you *have* to become a loss leader in the company's ledgers.
2. As I mentioned before, many women go through a working life without regarding it as a career or really getting committed to the company or the job. It is easy to do, because society will almost always approve a woman's returning to more "womanly" endeavors and will give her credit for whatever success she attained. (It would regard a man as a failure under the same circumstances, of course.) Such women just never get really committed to their professions, and a company never really knows what it can gamble on that employee's job. This presents a dilemma for women, I am sure, and I do not know the whole answer. But someone has suggested that at least some women should regard their professions as a mixed-racial marriage. Just make up your mind in advance that you're going to tough it out, and you may change some of society's attitudes.

I think that, particularly for engineers and scientists, this would be a tenable policy. Regard yourself as a professional and your work as a life-long career. Combine it with marriage if you wish, even time off for a family. Move to other companies if you want, but be an engineer. There are some great models for this way of life, of course, and more of them would make a real contribution to the cause of women's rights in the working world.

Also, there are women who don't play fair with the company. For safety's sake here, I quote *Business Week's* story again: "There's nobody . . . . executives dislike as heartily as the college graduate who doesn't plan to work past her first child, but persuades some employer to give her a career-oriented job. The day she quits, she leaves two victims: the boss who didn't expect her to quit, and the genuinely career-minded woman he won't hire or promote as a result."

Next, I think women professionals must undertake to educate the general public to their capabilities, their attitudes toward work and their professions—not the strident Woman's Lib approach, please. Not because she's necessarily wrong for her purposes, but because the skilled, conscientious, and contributing woman has a *better* story to tell, and the public will listen and learn and change the prejudices that clutter up the whole subject.

And finally, I think we all must sell engineering—and science—as an occupation. We are going to need more people, and perhaps your Society, Mrs. Salembier, can do the most in this area. I recently saw an SRI film reflecting college students' attitudes and I was impressed by one thing. The men who complained about social problems and their dislike of establishment values were vague about their future plans. One had been in college for nine years; another only knew he didn't want a regular job.

But the women were not vague. One wanted to become an architect to invent effective low-cost housing for blacks. Another felt computer technology held some keys to social solutions, and so on. It may well be that women, with their famous intuitions, have sensed that now is the time—not for talkers and marchers, but for properly oriented do-ers—engineers and organizers who will be able to help solve the problems.

I know the Society of Women Engineers is heavily involved in attracting women students to engineering. Your communications and programs reflect it, and I encourage you to put even more emphasis upon encouraging capable young women to look toward engineering for their careers.

Well, I have tried to give you some sense of how I think industry regards our subject. I have tried to inject some pertinent facts of business life. I have outlined some ideas that have costs attached—probably not unreasonable costs. But these and other ideas can be tenable, women can make these desirable gains, and industry can profit by their services only so long as in a net sense they pay—or rather *earn*—their way.

Stanley W. Burriss

Stanley W. Burriss, President of Lockheed Missiles and Space Company, is also Group Vice President of Lockheed Aircraft Corporation. From Newark College of Engineering he holds a B.S. degree in electrical engineering, 1938, and an honorary doctor of engineering degree, 1964. He has worked in a number of engineering capacities for Otis Elevator Company, the United States Navy as a lieutenant commander, Los Alamos Scientific Laboratory, the Martin Company, as well as Lockheed Missiles and Space Company which he joined in 1954. Since that time Mr. Burriss has been concerned with many phases of the company and the corporation activities.

Mr. Burriss received a Certificate of Appreciation from the Secretary of the Army in 1953 and the United States Navy Meritorious Public Service Award in 1961. In 1962 his alma mater presented him with the Edward F. Weston Distinguished Alumnus Award.

A Government View: Women and Legislation

The Honorable Martha W. Griffiths
United States Representative from Michigan

I should like to begin my talk by discussing the recruiting problem. If I send out a recruiter and I discover that no women came to inquire about a job, I would look to see what the recruiter did. I would look, secondly, to see what the college or university did, because I would have real suspicion that the university is not informing women that the recruiter is on campus, that jobs are available, and that the person who is doing the recruiting wants to talk with women.

As a lawyer, I would like to tell you that there never has been a prestige law firm in this country which goes to a university and asks to speak with women students unless the university insists upon it.

The University of Michigan last year required all law firms to interview women. They barred from interviews all firms who would not hire or interview women. I was at Duke University in the spring, and women were putting on a real drive to see that Eastern law firms were required to interview them. I was amazed to find on campus one girl who was then graduating in law but who was already a graduate accountant passing the C.P.A. exams first in the United States. That little girl was the most valuable potential lawyer in that place for a firm doing tax work. Imagine a firm turning down an opportunity to interview her. It was ridiculous, and yet those kids at the school were in a real bind and their tensions were running very high as to whether or not the faculty would lay down rules that would say to the law firms: You also must interview the women.

Now I would like to say what I consider the objective to be: To bring women into the human race; to show women that in reality men and women both have a world in which to live. We must show how the world really is being run and get rid of the old myths.

I feel that the old myths govern our lives, and, therefore, I am anxious that both men and women everywhere understand the things that we are doing and how they affect us. I am going to begin by discussing with you the latest legislation that has come from the House Ways and Means Committee, which is part of the old myths. I refer specifically to welfare-social security.

Since I have been a member of Ways and Means, I have urged the committee to require not that every father support his child, but that every parent be responsible for that child. I want them to say to a young woman, "If you want to have a baby at 14 years of age, you are free to do so, but, my dear, you are going to have to support that child."

What are the problems here? In the first place, the poor girl carrying a child cannot get an education. There are local ordinances all over this country that say that when a girl has a baby out of wedlock, she no longer is allowed to attend high school. Nobody has ever bothered about the father, because, of course, he has to support the family. But, that little teenage girl has laid upon her the greatest burden of any person in our society. And yet, we still are enacting laws that say that the girl has to remain at home until the child is at least three years old.

Finally, this year we got into the committee report on the social security-welfare bill that day care has to be made available to her; that she has to be permitted to go to school; and that she has to be given the first chance. But, how many children have to be born this way before we wake up to the fact that a few years ago there were two and a half million women and children on Aid to Dependent Children? Then it became five million, now it is seven and a half, and, before the decade is over, it will be 20 million. Ten percent of all American

children will be reared on A.D.C., and we still are making laws that require that men be given first chance at training and first opportunity at jobs.

Welfare itself is really the result of discrimination and largely has been directed towards women. It was created by men who believed that women should stay at home—that all "nice" women remain at home. This is not true of the lower classes.

The real truth is that of 80 percent of our college graduates, a woman working today at the age of 35 will continue to work an additional 27 years if she is married; a little longer if she is single, and longer than that if she is divorced.

What we need to do is to make this picture known to both men and women, so that they can understand the reality of the world. One of the reasons I feel that women had refused chances at additional training, and I understand that in the early '50's women did refuse these chances, was because of counselors in high schools and, in addition, certain myths that men do not like cultured women, carried over from the idea that men never make passes at girls who wear glasses.

Let women look at the real world. In the real world today there are an amazing number of divorces of couples in their fifties. Now, no woman in her right mind who has never worked outside the home is going to ask for a divorce in her fifties. Men are asking for those divorces, and, in general, it is the men who have been highly successful. And, for whom do they trade their housewives? Why, it is the career girl. Women have to wake up to this. Today we are living in a world in which the old myths have been or are being destroyed, the ideas by which our mothers or grandmothers were reared are long gone.

Now, I would feel that I had lost a real opportunity if I had not emphasized this point. For all the employers, I have sad news. If the social security bill already passed by the House passes in the Senate, next year the base on which you pay social security is going up to $10,500. This is a 5½ percent rate for you and your employees.

Only one percent of the women in the United States make more than $10,000 per year and every one in America is going to be paying on their full salaries. Now, supposing a woman makes $9,000 and her husband makes $9,000—together they are going to pay 5½ percent on $18,000. But, if the man made $9,000 at two different jobs, when he made out his income tax return he could take a credit for everything above $10,500. But, if a husband and wife make out a joint return, they cannot take any credit at all.

Things get rapidly worse. When the man who works and supports his wife, who has stayed at home, retires he is going to draw on the full base and his wife is going to draw 50 percent from his base. When he dies—and die he will before her since women live longer than men—she is going to get 100 percent of what he draws. But for that couple that made $9,000 each, the top on which they ever will draw is $9,000. Therefore, if they both paid together on $10,500, they will get less under social security while they live, and either of the survivors will draw less than the widow of the man who paid on $10,500.

Who is the working woman paying into social security taking care of? Herself? Her children? Certainly not her husband. Her husband cannot draw on her account at all, unless she was supplying more than half of their income. That woman paying social security taxes as a worker is taking care of the wife who did not work.

I do not mind the myth of every woman at home, if the man really did take care of her, but often he does not. Many women are the sole support of families, due to the untimely death or disability of their husbands, or because they have been left alone.

All you have to do is look in any direction and you will find laws are

involved with sex discrimination. Take the Air Force. Until a few months ago, when I complained bitterly before the House Judiciary Committee, a woman to enter the Air Force as a volunteer had to have a high school education, which was not required of a man. In addition, as one of the real horrors, she had to send in four photographs of herself, one profile of her face, one profile of her body, one full face, and one full body. May I ask what the Air Force wants? What are they looking for? What kind of nonsense is that?

Now that is changed, I am happy to say. But all of the Service laws—all of the Federal Service laws—have this exact problem. For sixteen years I have paid into a pension fund the exact amount of any of my male colleagues in Congress, but if I die before my husband, my husband will not get any of the money I have paid into the fund. The law did not look at who was paying the money, nor the fact that widowers also can need money.

Until I came on the Ways and Means Committee, if you were a woman, your own children could not draw on your social security. The first year after I was able to correct this inequity, $100 million was paid to the dependents of women. Until then, we had been taking care of the foster children of men and their aged parents, their mothers-in-law, and whomever else we took care of, but never anything for a woman and her dependents.

Now, of course, the law is on to much of this unfairness. But there are still a lot of pension funds that do exactly the same thing. They are paying to widows but not to the survivors of the workers.

There has been some progress. Under the 1964 Civil Rights Act, we put in Title VII the word "sex." The act was designed to give minorities the rights of white people, but no one had ever thought that white women did not have those rights. If you gave minorities the rights of white men, did you mean, for example, that black women were going to get those rights which were denied to white women?

I kept pushing in my speeches in the House and finally we won—an amendment was approved in the Civil Rights Act prohibiting discrimination in employment not only because of race, color, or national origin but because of sex. Did it work? Yes, to some extent. One case has been brought under this law. Other cases should be brought. It is a means by which women can, in fact, enforce the 14th Amendment for themselves; and to any of you who may ask what does the 14th Amendment have to do with it, I answer: It does not. The Supreme Court of the United States never has admitted that any woman is entitled to the equal protection of the law, or that any women has any right to keep property from being taken from her, under the 14th Amendment. Case after case after case has been brought, and every time that little relic of the Middle Ages, the Supreme Court, has ruled that women do not have any rights.

Any law that is made that says we are protecting the safety of women and the safety of the human race by protecting women is valid for the Supreme Court. At any rate, the fact that the Civil Rights Act has been amended to include women is of some help. I would like to give you an interesting incident.

One of the first letters that came to me after the bill was passed was from a young woman who worked for a public utility in Louisiana. She wrote to say that it was practice in that company to fire women who married. She said that no woman ever wanted to leave her job, but that no woman could do anything about it. She asked if the Civil Rights Act could protect her. She planned to marry in June. I called her back and told her that the Civil Rights Act would go into effect the first of July and would apply to anything that happened within 30 days. I told her to advise the company and not to quit. A few days later a newspaper reporter came in and said to me, "Are any women writing to you?" I said, "Yes." He was a very good reporter and he called up the company and asked them what they were going to do. The person who answered said, "My

God, did you think that thing applied to women?" The reporter answered, "Yes, it does." The man said, "For Heaven's sake, we already have taken the blacks in, and we take care of them."

Months passed and I did not hear from this girl. Finally, I could not stand it any longer. I wrote and asked what had happened to her. She wrote back, and her very first words were, "Please do not write to me anymore. It will affect the company—it upsets the company. I still have my job but the company called me in and told me that they had been planning to do this all the time." She said the Civil Rights Act had nothing to do with it. I said to her, "I hope you keep this letter, and I hope you have a happy life. You are one of those who are making women human in the eyes of the world."

I would like to give you another example of legislation that is good for women. Even before the Civil Rights Act, an act was passed for equal pay for equal work. For a long time it lay dormant, but what amazes me is that there is no publicity now about the success of this act as it is working on behalf of women. The results of actions are never wired back and written up in the newspapers. I noticed the other day an item in one of the papers that one company was being sued by 20 women employees for something like half a million dollars. I am pretty sure that those 20 women are going to win their sex discrimination suit. That is quite a lot of money, and I would think that when they win, it would be headline news, but you see, if you do not tell anybody about these actions, you discourage other women from doing the same thing and asking for the money they deserve.

Let me give you some examples. Remember that in most of these cases where equal pay is being asked, the unions must be considered. Unions are equally responsible with the company, and in my opinion, they should be sued. One group of women obtained a very substantial settlement from their employer. The union president had the nerve to go to those women and get them to agree to divide the money among all employees. Most unions represent their male members and not the women. All you have to do is look at the Ladies Garment Workers Union. Although most of the members are women, they never have had a woman as president and there is only one woman on the Board. To me, that means trouble.

In colleges and universities there has been some tremendous research regarding the number of Master's degrees given to women and the fact that women can be top teaching and research assistants. But the moment a woman gets her degree, all at once she is not worth as much as her male counterpart. She has no opportunity and cannot find a job.

They just sent across my desk one of the worst and the funniest of all examples. At Duke University, not only did they have every other restriction known to man, but they required that all women live on campus and pay rent. The Dean of Men did not, but the Dean of Women did. She checked this and went to the president and objected to the practice. She was fired from her job.

These are some of the discriminations women face. The main problem remains, how can we change the attitude of the people, because no woman wants this situation. One of the things we need to do is to show both men and women that in the real world there are laws which discriminate. They discriminate against the wage earner in the family. The husband is discriminated against; the children are discriminated against. A woman's children do not have the same opportunities as a man's. This is true whether she is a divorcee or married. Is this what we mean by justice? It is ridiculous.

We want to live in a world where every person has equal rights. My grandmother was left a widow and she reared three little boys and put them through high school, which was the equivalent of a college education in those days. None of her neighbors did that. She was first in line when women had the

right to vote, and she believed that before she died she would have the right to vote for a woman for President.

I do not believe that what she believed will happen soon. One of the reasons is that to have a woman president of anything, she has to be given all of the opportunities and promotions, and all of the opportunity at the steering wheel that a man is given. Women now are not being given those rights. But I believe that before I die, it would not be impossible to put a woman on the Supreme Court and have that body finally look down at a woman and say, "Yes. The Constitution of the United States applies to all people."

Discussion

Question: I would like to know why it is so necessary to get Congressional action so that the husbands of women in the military can have the same privileges.

Mrs. Griffiths: It is silly. I have had a bill in for years. For example, if men have wives with them and live outside the quarters, they get an allowance, but if a woman is living with her husband and she is in the military, they do not get an allowance for him. What you really are doing is reducing the rights of the women.

This matter came to my attention through a distinguished woman visiting in Detroit. She was in Vietnam before things got hot. She and her husband are doctors and were employed by the government. When the government decided that women must go home, they notified this woman that she had to leave. She said, "Well, you know I am not a dependent, I am an employee." This was too much for the Army—she had to go home. So, she went home. At that time, they still were employing women doctors in Vietnam, but none of their husbands were there. Let us be brutally frank. It did not make a difference whom you were sleeping with as long as you were not married to him. What kind of a government policy is that? That is ridiculous.

On the whole, most of the statutes are written by men. I have been told by some women in the Armed Forces that one of the reasons that I cannot get all of these bills passed is because the secretaries are men. It always turns out that there is something far more important than treating women fairly.

Question: Well, the Equal Rights Amendment* says that . . . .

Answer: I am going to stop you right there. The real secret of the Equal Rights Amendment is that equalization will come about in law and this is where it should be, because it will be required by law. It would be wonderfully helpful if you would write to your congressmen on the Equal Rights Amendment. If you have not written yet, please do.

Question: I am with the Department of Defense. All these laws are wonderful on the books and you can approach private industry and force them to abide by these laws, but how do you do the same with the Department of Defense?

Answer: Well, of course, the attempt is being made. You have great difficulty in getting the departments to change their regulations or even to interview women, and give them a better job.

*Editor's Note: The Equal Rights Amendment is discussed in the talk by J.G. Gutwillig, Page 34.

I might say to you, too, that one of the things that has always amazed me is the sex in the Civil Rights Act. One of the women who came to me and asked for assistance was a woman who played baseball. She was a little, tiny, blonde thing and looked like she weighed 110 pounds. She was very attractive. This girl had played baseball for years at county fairs with the professionals. She could hit a ball 340 feet. None of the leagues would sign her up so finally she went to Umpire School. When somebody hired her, the Commissioner of Baseball then said that, of course, you could not have a woman umpire. I regarded that as one of the silliest statements ever made. Baseball is popular, and you would think that people would come out to see a woman umpire. I could not believe that the old protective stance still applies: "She could not hear the language."

Question: I am the co-chairman of Workshop Five, which is devoted to a program for participation of women engineers in education, and one of the expected outputs of the workshop is a set of recommendations for action. We decided that the law might be one of the things that would pop up. I would love to hear what you would say. Women engineers in education—what kinds of action would you recommend?

Answer: Well, you have available already quite a few laws. What you would need to do, and what I think should be done, is that prior cases should be brought and cited—cases for equal pay for women engineers, for promotions, and the right to apply for a job. I would go into a place that only has men engineers and I would send in a woman. When they turned her away, I would bring action. And women are doing this. There is a group of women lawyers that are going to bring these actions. Women professionals should pave their own way. That is the way I feel about it. Ask for a p y increase. Men are paid enough for the support of their families, so why are not women?

Question: I know of one case where a woman did ask for a pay increase and then brought up the article at the University of Michigan and, I think, the University of Illinois, too. She said, "Now I will go to HEW if I don't get this raise or this promotion or a retainer, and, if I go to HEW, the whole institution will be scrutinized."

Answer: But that is a final action. I would take positive action. HEW settled with the University of Michigan for far too little. HEW should have been much tougher—there is no excuse. This is one of the great universities of the world, and women should be given opportunities.

Martha W. Griffiths

Martha W. Griffiths has been United States Representative from the 17th Congressional District of Michigan continuously since 1955. She received the B.A. degree from the University of Missouri and the J.D. degree from the University of Michigan. She was admitted to the Michigan bar in 1941 and to practice before the United States Supreme Court in 1955. Mrs. Griffiths served in the Michigan State Legislature from 1949 to 1952, was the first woman to hold the post of judge and recorder of the Detroit Recording Court in 1953 and was a member of the Detroit Election Commission. As a member of the Ways and Means Committee and the Joint Economic Committee and as Chairman of

its Fiscal Policy Subcommittee, Mrs. Griffiths' interests are directed toward social security, medicare, tax and welfare reform and fiscal policy. She has made special effort to correct injustices confronting women in employment. During the 91st Congress she sponsored the Equal Rights Amendment and successfully guided its passage through the House. In addition she has introduced a major health insurance proposal to make comprehensive health care services available to all Americans.

Mrs. Griffiths is the recipient of honorary degrees from Eastern Michigan University (1963); Mercy College of Detroit (1966); Michigan State University (1966); and Wilson College of Pennsylvania (1971). She is the recipient of the Outstanding Alumni Award, University of Missouri (1968); President's Cabinet Award, University of Detroit (1970); Outstanding Achievement Award, University of Michigan (1970); and the 1971 Annual Award of the League for Industrial Democracy. She is married to Hicks G. Griffiths, attorney, Detroit, Michigan.

The Guidance Approach – Part I

David R. Reyes-Guerra
Executive Director, *Engineers' Council for Professional Development*

Delivered by John Alden
Executive Secretary, *Engineering Manpower Commission*

Basically, this conference has been geared to those already practicing engineering. In my case, I would like to make a strong stand for those who are not yet in the practice of engineering: the young people who in the future will become the practitioners or users of the profession.

My main interest is the youth market to whom we hope to provide correct information about careers in engineering so that they can make a better choice, a more informed choice, when the time comes for them to decide which career to enter.

Engineering is not a difficult subject to talk about if we approach it from the functional and academic side. However, it becomes extremely complex when broken into specialties. Everyone in his daily life comes in contact with the products of engineering but it is extremely difficult to open the eyes of people to the engineering facts. Engineering is a "taken for granted" profession: it will always be there; someone will be doing it; thus why bother?—something like our old concept of air and water. We are attempting to create among the youth, not necessarily a favorable idea about engineering and technology, but a true picture of what it is, what it involves and what it can provide, as a career, for the individual who practices this profession. This same concept we hope to inculcate among teachers and other adults.

Of major concern, however, is the fact that we have not been able to get the "ear" of women when we talk about engineering. This is my primary concern with you.

Women in the engineering profession make up only 1 percent of the membership. The same percentage applies to blacks, both men and women. The relationship is not one based on the same conditions, however. In my estimation, women are to be considered a minority in engineering the same way as blacks. Since women are a minority, it is our responsibility to make an extra special effort to convey to them ideas and materials that will give them a better understanding and education about engineering and our world of technology.

There is no reason whatsoever why the challenge of an engineering education should not be as stimulating to a girl as it is to a boy. There is no reason why the practice of engineering should be different for males and females. As a matter of fact, in certain professional engineering areas it has been proved that women are more efficient than men. This sometimes is attributed to the trait of a woman being more neat and more patient in her work habits. These two characteristics are very important in certain engineering functions. Therefore, women with technical know-how have a slightly upper hand over their male colleagues in these specialized functions.

One of the main points I wish to make is that we have to create a different image of the engineer among youth—an image that reflects favorably upon women as members of the profession. We are fighting a losing battle when we only refer to the academic, monetary and practical opportunities involved in engineering. We have not spoken about "creating for the *betterment* of man." The social and human relevance of engineering has been lost in our exposures.

We are losing our battle with parents, who are one or two generations

removed from the young people and who tend to constantly think of engineering as a completely unfeminine, dehumanizing and defeminizing profession. Any young girl in school who thinks in terms of engineering is usually mocked by not only her peers, but also by parents and other relatives.

We need to show that engineering is not an unfeminine profession and it does not force women into losing their femininity. Engineering is compatible with marriage and a family. It allows for growth: academically, intellectually and in every other aspect. Women engineers are not "mannish" looking persons, they are not "ugly ducklings." As a matter of fact, women engineers are physically as competent and as charming as other women practicing a profession. They are not freaks; they are very personable, dedicated and likeable people.

The above communication problems are facing us today and I hope this particular meeting will be able to generate some ideas as to how we can impress upon the young people, their parents and teachers, a different picture of women in engineering. We have to try and break down the old and wrongful notions that are being generated about engineering being a profession for males. I have some ideas as to how this can be done, however, we would rather hear yours. We do not have a large enough number of women in engineering, which limits a person to person approach in changing erroneous concepts. We need an effective mass media methodology.

I would like to suggest that efforts be made to promote advertising women engineers in connection with women oriented publications. We would like to see young girls reading in some of their magazines, material pertaining to girls who are engineers or who are interested in engineering. We need examples of work being done by women in engineering, their positions in industry, in education and in government. In other words, I am talking about all of us trying through many corporate facilities and our public relations offices, to spend a little bit of our time, money and effort in talking to the women of America about what the engineering profession is all about.

The challenge is yours, the ideas are many and the price may be high. The technical obsolescence and a second rate technological environment, however, are not gratifying thoughts. If we do not use our womanpower efficiently in areas such as engineering, the future seems to point to such consequences.

I hope that some of our workshops will address themselves to youth and will provide ideas as to how we can change the unfeminine image of engineering so that young girls will be able to consider engineering as a future career choice without any stigma or bad feeling about having considered this profession.

David R. Reyes-Guerra

David R. Reyes-Guerra, Executive Secretary of the Engineers' Council for Professional Development, Inc., was born in London, England. He received a baccalaureate degree from The Citadel and a master's degree in engineering from Yale University. After practicing civil engineering for a few years, both in the United States and Central America, he joined the faculty of the University of Illinois for ten years. Subsequently he served four years as Guidance Director for the Engineers' Council for Professional Development before moving to his present position where he is concerned with engineering school accreditation, ethics, development of students and young engineers and guidance.

Mr. Reyes-Guerra is the executive director of the Junior Engineering Technical Society, better known as JETS, an organization devoted to informing youth about career possibilities in engineering, and is a member of several

professional organizations including the American Society of Civil Engineers, the American Society for Engineering Education, the American Concrete Institute, the National Science Teachers Association and the American Personnel & Guidance Association. He is also active in international programs and serves as the secretary-treasurer for the Fund of the Pan American Federation of Engineering Associations (UPADI). Mr. Reyes-Guerra is the author of many professional papers and has co-authored and contributed material to various books. In addition, he is the executive editor of *Industrial Quimica Pan Americana*, a leading chemical industry journal in Latin America.

The Guidance Approach – Part II

John Alden
Executive Secretary, *Engineering Manpower Commission*

While I agree completely with David Reyes-Guerra's remarks on the question of guidance and public information, I would like to add a few words of my own on matters germane to this Conference, derived from my own experience in the engineering manpower field. First, I want to disavow any male chauvinistic intent in the use of the term "manpower," which, of course, includes humans of both sexes. The Engineering Manpower Commission of the Engineers' Joint Council, an advisory group which I serve as Executive Secretary, has two women engineers in its membership of forty-five—which may seem like a very small representation until you compare it with the proportion of women in engineering in general.

You have heard the figure one percent used rather frequently. Actually, less than one half of one percent of United States engineers are women. The number is so small that statistics are not readily available and are frequently unreliable. According to the survey of degrees conducted by my office last year, there were at least 358 bachelor's degrees in engineering earned by women. The true total was undoubtedly slightly higher due to incomplete reporting from several schools. While this number is less than one percent of the number of engineering degrees awarded, it represents a growth of about 250 percent over 1965. Prior to that date, the number of women engineering graduates had fluctuated rather markedly, with practically none in the pre-World War II years, a low of 33 in 1953, and a high of 169 in 1948.

In the case of advanced degrees, only five women earned Engineering Master's degrees in 1946. The number grew slowly but quite steadily to 44 in 1965, then rapidly to 170 last year. As for doctorates, 1948 is the first year for which I can find a record of any having been completed, and there are probably still fewer than 100 women in the United States with Doctor's degrees in engineering.

The Society of Women Engineers identified 1701 women enrolled as undergraduates in Engineering in the Fall of 1969. Our own survey, which included non-ECPD-accredited schools as well as 71 schools that did not respond to the SWE survey, showed about 3,200, or slightly over one percent of the entire undergraduate engineering population. I hope that this figure presages a continuing growth in the proportion of women entering engineering.

In past years of shortages of engineers, we have tended to look on women as an untapped source of new manpower. We could obviously double the number of engineering students if we could attract as many women as men into this field of study. By contrast, attracting a proportionate number of blacks into engineering would give a potential increase of only 10 percent.

However, I think the real issue is not one of exploiting new sources of manpower, even if we were not faced with a current oversupply of scientists and engineers, but of (1) improving the profession qualitatively by bringing into it the fresh outlook of women and men of all races, and (2) providing tangible opportunities for career satisfaction and public service to members of groups that are currently excluded, either overtly by discrimination practices or, as I believe to be more the case, by misunderstanding and inadequate knowledge that the opportunities exist.

Let me touch briefly on the attitudes that turn women away from engineering. Before leaving home for this Conference, I mentioned to several women—all college-educated, I might add—that I was going to a meeting on

women in engineering. "What—all three of them?," one joked. Another said that women were obviously not welcomed by the profession but when I asked her for specifics, she admitted she was going by what she had heard as a college student—over 20 years ago!

Another example was a recent editorial in *The New York Times* which charged quite gratuitously, and without presenting any evidence, that women in engineering and architecture were treated as "lepers." (This did not prevent the same paper from running an article a few weeks later about women graduates, including an engineer, who were being eagerly recruited by industry.)

What are the facts about women in engineering? I do not know the kinds of subtle or not-so-subtle discrimination that women are subjected to. That is something I came here to find out. I do know, though, that women engineering graduates are being offered salaries almost identical to those of their male classmates, as reported by the College Placement Council, Inc. What is more, the level of these salaries, averaging about $875 per month at the bachelor's degree level, far exceeded what was available to women in nearly every other field of employment; and in almost every other field, there was a noticeable differential between the sexes. I am sure I do not need to spell out which was obtaining the higher salaries.

It may be that discrimination rears its ugly head later on in a woman engineer's career, but the available statistics indicate that salary-wise, she starts out on an equal basis. I hope that her later opportunities for advancement are based on the value of excellence of performance, sound logic, and rationality that we like to think are the hallmarks of the engineering approach.

In conclusion, I would like to pick up a phrase used by Congresswoman Martha Griffiths this morning when she talked about learning "how the world is really run." This is a world of technology, whether we like it or not. Only technology permits us to support the earth's population in its present condition; and while technology alone cannot solve the world's problems, it is unthinkable that they can be solved without the aid of technology. What is more important, then, than that educated people and informed citizens have an adequate understanding of technology and its relation to society? The real problem in our educational system today is not that engineers are ignorant in humanistic and social studies, but that humanists, social scientists, lawyers, legislators, and housewives are so ignorant about technology.

Perhaps it is too much to expect that you who are here tonight will go forth and recruit thousands of young women to become engineers. I think you will deserve great credit and will perform a real service if you only convince people, through your example, that technology in today's world is just as much a woman's concern as a man's. Thank you.

John Alden

John Alden, Director of Manpower for the Engineers Joint Council in New York City, is a graduate of Cornell University with a major in Chemistry and of the Massachusetts Institute of Technology with a B.S. in Electrical Engineering. He served in the United States Navy for twenty-two years as an Engineering Duty Officer in a variety of positions connected with the management of the Navy's ship construction and repair program. Mr. Alden is currently responsible for the Council's program of surveys and publications on such subjects as supply and demand, salaries, and the utilization of engineers and technologists in the United States. In addition to numerous publications and articles dealing with

engineering manpower, he is co-author of a Career Guidance book on Engineering, and author of several articles and monographs on United States naval history, a subject he has continued to pursue as a hobby since retiring from active duty. Mr. Alden is a member of the American Society for Engineering Education, the American Society of Naval Engineers, and the Marine Technology Society.

The Citizens' Advisory Committee on the Status of Women

Jacqueline G. Gutwillig
Chairman, *Citizens' Advisory Committee on the Status of Women*

I thought I was just going to come to this Conference to listen, then go back to my work in Washington with much more knowledge and information that would help us accomplish our program. But I am very glad to have this opportunity to explain to you what the Council is and what we are trying to do.

The Citizens' Advisory Council on the Status of Women was established by Executive Order in 1963 as a result of an ad hoc committee, which was called the President's Commission on the Status of Women, appointed by President Kennedy and chaired by Mrs. Eleanor Roosevelt. That Commission recommended that the Council be formed and an Interdepartmental Committee on the Status of Women be established. The Interdepartmental Committee is composed of the Cabinet Officers and the Directors of certain government agencies that have to do with labor and employment.

The Council is composed of twenty members—volunteers appointed directly by the President, who serve without compensation and who are appointed for an indefinite period. I suppose this means that if Mr. Nixon doesn't like what we are doing, we will get a nice letter of "thank you very much." So far we haven't gotten a letter, although we have done quite a few things which have been a little different than what the previous Councils have done.

We are "action-oriented." One of the first things we did was to endorse the Equal Rights Amendment, which as some of you know has been run around Congress for 47 years. Most women's organizations endorse it. More and more of the large women's organizations are endorsing it year after year. Many of the members of industry are for it. I will tell you that unions are not for it. Why unions feel that the Equal Rights Amendment might be a threat is because they feel that if enough women are employed it might take jobs away from men, although they don't quite say it that way.

Being a volunteer group, the Council can operate free from the constraints of bureaucracy, although we use their expertise and get them to provide technical assistance and to write technical papers for us. As an example of how we can operate, our Equal Rights Memorandum has been used by practically all the proponents when there have been hearings in Congress. I used it when I spoke at one of the hearings for the Equal Rights Amendment.* There have been over 20,000 copies of this Memorandum sent out from our office, which is in the Department of Labor. Our entire staff consists of one secretary and an Executive Director, so I want you to know that sending out 20,000 copies is a really monumental job.

Although Martha Griffiths did not mention it yesterday, she has told people that the stature of the Council was one of the major reasons she took the action she did last year to get a discharge petition on the Equal Rights Amendment. Those of you who are not familiar with Congress may not know what that means. It means she had the bill brought out of Committee, onto the floor of the House, and obtained enough signatures of the members of Congress to have

*Editors' Note: As of the date of going to press, the Equal Rights Amendment had passed the Senate and had been ratified by 17 States.

it discharged and sent over to the Senate. What she did is something very few people have the courage to do.

I want to go into a little detail with you, since it is very important for industry to know what the Equal Rights Amendment is, what it can and cannot do, and for women to know what it is.

A Senator put a rider on the bill to the effect that there would have to be prayers in the schools. It really had nothing to do with the bill, but the Senator who put it on felt, I am sure, that it was the best way to kill the bill. Then another Senator put on another rider that women would be exempt from the draft. As a result, all of us, all the women's organizations and all of the people who were for equal rights for women, wanted the bill killed. We said there was no purpose in having it if women are exempt from anything.

When I spoke at the hearing, I spoke on the draft. I was the only female who was in the military service who spoke at those hearings, so this was a good subject for me. I say that there is no reason why a woman should not have the same opportunity of serving her country as her brother has or her boy friend or her husband or her father. You know, as well as I do, that in the service people are put in jobs for which they are qualified. There are many men who are not necessarily in the combat area. I don't think women should be excluded from combat, but this may not be necessary. They will be put in jobs that they can fill. (Furthermore this is getting to be a question that is really not very important any more. We will undoubtedly have a volunteer army within the next two, three, four or five years.) In any case, under the rider, women would be denied equal rights in this respect. Furthermore, they would continue to be denied the advantage of veteran's preference which now gives men an opportunity to get a job over women, because very few women have veteran's preference.

Incidentally, I have veteran's preference; and I found out, because I was interested in looking this up, that because I was in the military and because of my working years on salary, that when I come to collect Social Security I can get more by collecting my own than my husband's.

I'd like to give you two examples of why most opponents are worried about the Equal Rights Amendment. One is the fact that in a divorce the woman would not necessarily get the entire settlement she gets today. Frankly I think it would be better to have settlements made on an equal basis. The court could decree the custody of the children to whichever one of the parents is better qualified to take care of those children. The court could decree whether or not there should be alimony. In the case where the woman is very wealthy and the man has nothing, the court could decree that she pay him alimony.

The other thing opponents are worried about is property rights. This issue is a little more complicated; but it does seem that if there is a specific question about property rights, the court can take this up when the case is presented and resolve the issue then.

Now the Equal Rights Amendment, if passed by Congress, will have to be ratified by at least 3/4 of the States of the Union. Even after it is ratified by those states, it will take two years for the bill to become an amendment. So we have plenty of time to think it over, discuss it and take any bugs out of it—and to find out if we really do want it.

I am going to provide you with a copy of our Annual Report, in which we have the Memorandum on the Equal Rights Amendment. Those of you who are interested, and I hope you all are, should read that. And I hope that you will take action as your conscience dictates.

Another of the Council's functions is to act on requests made by the Interdepartmental Committee. For example, they asked us to evaluate and make recommendations on a report that had been written by a Subcommittee on

Maternity Benefits (for Federally employed women). Currently the general procedure is that a woman can take sick leave, then regular vacation leave, and then time off without pay.

The Subcommittee's recommendation had been special leave for maternity. We looked into this report very carefully. We invited representatives from industry, the insurance companies and government to come in and talk to us at our meetings about this. After many position papers and much discussion, we recommended to the government that, for pregnancy, sick leave be advanced the same as it would be for any other temporary disability. The same recommendation was made to private industry. The insurance companies assure us that they will write that kind of insurance for companies and that they have never yet refused to do it. That paper is also in our Annual Report, and I make a plea to those of you here from industry to see that, if your maternity benefits are not in line in this respect, you do make a review of them and consider that maternity is equal to any other temporary disability.

Another area in which we have a great deal of interest is educational counselling. I was glad to see yesterday and today that there was some discussion here of the importance of good counselling at the high school level. I am not sure how this can be accomplished. I think that as far as we are concerned all we can do is advise, guide and recommend to the government. But we can certainly talk with groups who are seeking competent counselling. We can help bring out points to educators, suggesting more technical counselling and the importance of being alerted to the needs of the girls rather than suggesting that they go ahead and be a nurse or a secretary. There is nothing wrong with either of those jobs, but as engineers you know there are many other things that women like to do and can do.

I did want to mention our Affirmative Action Program, which is really the reason I am here. This is a new program on which we hope we will soon be able to make a report to the President. Our recommendations will be for government, but hopefully they will provide guidance for industry. There has already been much interest shown in this by industry. The personnel department of one company called for specific advice on what kind of guidance we could give so that they can employ women in the proper manner, so that they will find qualified women and so that they will be able to advance women within their own organization. Naturally we cannot dictate exactly the way in which industry must do this; but we are going into the Program, and we have already recommended to the government certain changes in their own guidelines which are wrong in excluding women. There are things we can do in the federal government to help. It is my understanding that within about ninety days there will be new guidelines issued which will include women, as well as minorities.

One word about Women's Lib. I am not Women's Lib and I can speak for each member of the Council. They are not Women's Lib. Now when I say that, I am not saying anything against those who are members of the group. In one way they have done some good. They have alerted people to the fact that there is a lot of discrimination going on in this country. Now that they have achieved this, I hope they will get to a point where there will be credence given to what they say. If they do this they will help the cause immensely.

I hope that through this discussion you might understand more clearly what we are trying to do. In our Washington office there are pamphlets and materials which may be of interest and value to you. If we can help you in any way don't hesitate to write to us.

Jacqueline G. Gutwillig

Jacqueline G. Gutwillig is Chairman of the Citizens' Advisory Council on the Status of Women. She is a former business woman, a millinery buyer. She was National Assistant Director of Women's Activities and is currently regional volunteer advisor for the National Foundation of the March of Dimes. Her military experience has been as a Lieutenant Colonel in the United States Army, serving during World War II in Europe with General Eisenhower. She was decorated with the United States Bronze Star and has received the signal honor of receiving the British MBE (Member of the British Empire), an honor not often accorded to foreigners. She is married and lives in Phoenix, Arizona.

Women in Engineering
Some Perspectives on the Past, Present and Future

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I. Introduction: Nature and Scope of this Paper

It is probably fair to say that in terms of the role of women in engineering, and the other sciences, we are now in a transition period. As a recent top level report on science and engineering concluded: "We are experiencing the end of one period and the beginning of another."[1]

This paper is concerned with this transition. Part II will take a brief look at women in engineering in the 1960's. It will examine the labor market factors and find that many were favorable yet the role of women in engineering remained small. Part III tries to find the answers as to why limited progress was made by women in high levels of technology in the 1960's.

Will the 1970's be different? This is the question explored in Part IV. It will find that the 1970's will likely be very different. Part V will consider briefly the problems raised by the paraprofessional movement. Finally, Part VI will offer eight proposals that might assist in increasing the role of women in engineering and science, and in turn, increase the role of engineering and science in society.

II. The 1960's Looked Favorable for More Women in Engineering

The 1960's was a decade which, on the surface, looked very favorable for increased participation of women in engineering. In fact, as we moved through the decade, many knowledgeable observers predicted a rapid upsurge of women in engineering. (See Appendix B.)

These observers had considerable evidence to support them. There were many favorable factors at work. Some of these are worth noting.

First, *the supply side looked favorable.* Work rates rose for women at all ages. The overall rate went from 37 percent in 1960 to 42 percent in 1968, a gain of 13 percent. Among women 25 to 35 years of age the rise was from 34 to 42 percent, or a rise of 23 percent in ten years.[2]

Work rates rose rapidly for married women. The percent of the female labor force married rose from 52 percent in 1950 to 60 percent in 1960 and up to 64 percent by 1969. This was accompanied by rising rates for married women with school age children at home and even those with children under six. Much attention was given to the emerging double work life of women, an early work life, 20 to 24 years of age, and a second, 35 to 64 years of age.

The work life expectancy of women began to approach that of men. This fact received widespread recognition. In 1950 the work life expectancy of United States women was just 36 percent of men's. By 1960 it has risen to 49 percent and by 1970 is believed to have been somewhat above 60 percent.

Women's rising participation in work was accompanied by rising participation in higher education. The percent of women 18 and 19 years of age

[1] References are at end of paper.

enrolled in school went up from 31 percent to 42 percent, 1950 to 1960. Even more striking was the rise in enrollment of women in the age class, 20 to 24. The percent enrolled rose from 7.4 percent in 1960 to 16 percent in 1969, a rise considerably greater than for men. No other country has ever come close to educating so many women in this age class.

Women not only made spectacular gains in enrollment in higher education but their drop-out rate was less than for men. As a result the percent of all bachelor's degrees awarded to women rose from 38 percent in 1962 to 44 percent in 1969. The favorable trend was even more striking at the master's level. Women's share rose from 31 percent in 1962 to nearly 40 percent in 1969. There was a modest rise in women's share of doctorates from 11 percent in 1962 to 13 percent in 1969.

The evidence accumulated rapidly in the 1960's that women were utilizing this rising education for long-term careers. There developed a strong positive relationship between level of education and work rates, especially in the middle years. In 1968, of women with just elementary education in the age class 45-54, only 34 percent were working. If they had a high school diploma the rate rose to 56 percent. If they had four years of college it went up to 63 percent. If women had five years or more of college their work rate was 86 percent, almost as high as for men.

A study published in mid-decade was perhaps the capstone which ended the myth that investment in higher education for women was a poor investment since only a small percentage would work or work very much. It was found that nearly 80 percent of all college-educated women in the age class 45-54 were working. The percent who had worked at some time was 97.

Second, *the demand side was unprecedentedly favorable to women*, particularly in science and engineering. The expansion of R and D in industry, the longest expansion cycle in economic history, the space race with the Soviet Union, the expansion in institutions of higher education, combined to create a shortage of scientists and engineers without precedent. Industry, government, academe were forced and persuaded to pull down the barriers to the employment of women. That this did occur is confirmed by numerous studies during the 1960's. Women graduating in engineering after 1963 could pick and choose among job offers.

Third, as a result of strong public support for the space program, the *role of science and technology reached new highs in public prestige*. The achievements and contributions of women to the space program received widespread recognition.

Fourth, the need for more women in engineering in industry *received much attention in trade publications and numerous conferences by leading academic institutions* (See Appendix B). At least some of this "new look" trickled down to vocational guidance counselors and to parents.

Fifth, *Title VII of the Civil Rights Act of 1964*, after a faltering start, *became more meaningful toward the end of the 1960's as a means to assure equal opportunity for women not only in initial employment, but in promotion and protection against arbitrary dismissal.*

Finally it may be noted that *women's professional organizations such as SWE became much more active* in getting the message of this more favorable environment over to talented high school girls and women entering college.

In summary, the 1960's looked ever more favorable for more women in science in general and engineering in particular.

What actually happened? The answer is: "Very Little." There was a slow absolute annual increase in number of women enrolling in engineering but as a percent of total, the increase was very small.

III. Why so Little Progress for Women in Engineering in the 1960's?

If the supply and demand factors were so favorable, if so many barriers came down, if the achievements of outstanding women engineers received so much attention, why then didn't more women choose engineering as a career? With so many observers expecting it to happen, why didn't it happen?

To understand what really happened it might be well to consider another technologic puzzle which may illustrate in a parallel case what happened.

Consider for a moment the jig saw puzzle involved in the mechanization of the United States cotton economy. For 100 years prior to 1950, farmers, agricultural scientists, farm implement manufacturers, individual inventors, tried to find ways and means of applying technology to cotton growing and harvesting. Over 2,000 patents were filed 1840-1950. Yet after 100 years of effort, cotton was being grown and harvested in 1950 just about the same way as in 1850. All other major crops had been successfully mechanized except cotton. Why not? Why no progress in a century?

James M. Street in his *The New Revolution in the Cotton Economy* provides the answer.[3] Unlike all other crops, cotton could not be mechanized in stages. All stages, i.e., improvement in varieties grown, planting, defoliation, thinning, cultivation, picking, ginning, all had to be done at once. And there were bits and pieces missing. Not until 1950 did all the pieces finally fit together. And when they did—a revolution occurred. In ten years mechanization went from almost 0 to virtually 100 percent, accompanied by a human upheaval, the consequences of which are still with us.

Now return to the subject at hand. With so many factors favorable for the first time, why so little progress for women in engineering in the 1960's? Something was obviously missing. What was the missing piece that left the jig saw puzzle uncompleted?

The answer to the missing piece can be found by asking two questions: What did women seeking professional careers actually do? Why did they do so?

The answer to the first question is that career-bound women concentrated their higher education in just one professional field—teaching. In 1969, 80 percent of women's bachelors degrees were taken in just ten fields, 36 percent in education and 45 percent in the humanities, most of which were taken for use in teaching. At the master's level 52 percent of all women's degrees were in education and nearly 85 percent were in education plus the supporting humanities.

Why this concentration in teaching? There are several reasons. First, the demand for teachers at all levels was unprecedentedly high in the 1960's. There were no barriers anywhere. There was no need to break with tradition or the advice of high school counselors, friends, relatives. Secondly, teaching for women has had some unique advantages. Four of these may be noted. First, teaching, as an occupation, was ubiquitous. Jobs were everywhere. No matter where a husband might move, big city, little city, urban, suburban, or remote rural area, every community had a school system. There is no comparable occupation with this same unique quality which supports family mobility.

Second, teaching has had a high degree of "carry-over" and "carry-back" for women. Much of what is learned in teaching other people's children can be useful in teaching one's own. And after rearing one's own children, what has been learned in the process can be very helpful in teaching other people's children. Few occupations have this people-to-people transfer quality.

Third, teaching has been well adapted to the first and second occupational lives of women. A woman can teach a few years, drop out to raise her own family, and then unless she is going to teach at the college level, she needs little retraining in order to qualify for re-entry. Most other professional jobs require

considerable retraining in order to catch up with professional requirements.

And fourth, teaching has been particularly attractive to women because its seasonal pattern facilitates combining family responsibilities with work, with family vacations, holidays, etc.

Was the decision of talented women to give priority to teaching as a career successful? The answer is: "Yes, it was." In 1968, nearly 80 percent of all college women who worked, were working in the professions. And within the professions, teaching was the dominant occupation.

In summary, women didn't have to think too much about career planning in the 1960's. They could follow the traditional stream and do very well. In fact they could hardly make a mistake in terms of getting a professional job. This was the missing piece of the 1960's which explains the puzzle of why so limited an interest in engineering with its tremendous opportunities and challenges.

IV. Will the 1970's Be Any Different?

Will the 1970 years be any different? This is an easy question to answer. They will. They will be very, very different for women than the 1960's.

We are now in the transition stage and moving through it very rapidly. That is why the sponsors of this Conference are to be commended. Now is the appropriate time to look at the changes taking place. Perhaps not too many people are aware of how vast are these changes. There are serious problems ahead. Now is the right time to step aside and take a long look down the road so as to hopefully anticipate what is coming. By the time a "crisis" arrives, it is usually too late to undertake constructive planning.

Will More Career-Bound Women Look Seriously at Engineering in the 1970's? I submit that the answer is "yes"—much more so than in the 1960's. Why should this be so? There are a number of reasons to support this prediction.

First, *more women will be forced to look at engineering and all the sciences.* They will find they must consider breaking with tradition. The reason for this is well known. Teaching, the traditional primary profession for college women, will not be able to absorb the rising numbers of college women graduates as in the 1960's. Teaching is in for a tough shakeout, especially for women. Although the reasons for this are familiar to almost everyone, let me briefly summarize them. The great wave of rising enrollments in the elementary and secondary schools is now past us. We are in the backwash. New teacher openings crested at about 230,000 annually in 1968.[2] It is now falling and will reach about 185,000 in 1973, then level off. Meanwhile the number of college graduates seeking teaching positions continues to rise, making for a serious maladjustment in supply-demand relationships. The number of new teachers required as percent of graduates, crested at 35 in 1963. It is now down sharply to 18 and will drop to 14 by 1978. Within teaching the role of women is deteriorating at all levels. Women as percent of all elementary teachers has declined from 90 percent in 1930 to somewhat under 85 percent currently. At the secondary school level, the relative decline is even more dramatic. In 1930, women held 65 percent of all secondary school positions. In 1966 the percent was down to 47 and is believed currently to be under 45. At higher levels women are also losing out to men in teaching positions. In 1930, women held 28 percent of college positions. In 1966 it was somewhat under 19. The great expansion of education in the 1960's obscured this relative deterioration in women's role in teaching. It is now being exposed rather rudely.

Finally, it may be noted that public support of education has undergone revolutionary change. Money to expand, or even maintain, education is going to be hard to come by in the 1970's. Let me illustrate from experience in the State of Illinois. In 1950, it was estimated that 80 percent of all requests by local

school authorities for tax increases or approval of bond issues, were approved. In 1970 it was estimated that 80 percent were rejected. The honeymoon is over for public education, rightly or wrongly. Many talented women will be *forced to* look outside teaching for career opportunities.

Second, *engineering is changing—more women will want to look at engineering.* No profession likes to accept enrollees who have been forced into it because they have no prospects elsewhere. Involuntary students are seldom good students.

I submit that more talented women are going to look seriously at engineering because they will *want* to do so, not just because they are forced to do so. This will be so, because engineering itself is changing.

Engineering is broadening. It is deepening. It is becoming more interdisciplinary. It is becoming more and more concerned with human affairs and human problems.

The dictionary still defines engineering as follows:

> "the planning, designing, construction, or management of machinery, roads, bridges, buildings, fortifications, waterways, etc.". . .

and, one could add space vehicles.

This concept is now outmoded. Engineering is encompassing and interlocking as never before with a wide range of physical, social, environmental sciences.

Biomedical engineering will illustrate this trend. In 1945 the term was hardly known. But a handful of pioneer investigators said engineering could contribute greatly to the medical-health fields. This idea grew. There are now 3,000 professionals working in this interdiscipline. Over 30 institutions are currently offering training and the number is increasing rapidly. This new field has already spawned new interdisciplines on its own. Medical Computer Systems is one outstanding example.[4]

What has this to do with women in engineering? I submit it has much to do with it.

The "new" engineering disciplines extend deeply into areas that have traditionally been of very great interest and appeal to talented women. If yesterday you asked a talented young woman: "Would you like to build bridges?"—the answer might well be "maybe" or a flat "no." But if you asked a talented young woman tomorrow: "Would you like to design equipment to save lives?"—I think the answer is more likely to be: "Yes, yes I would like that very much."

In this connection permit me to quote from the eloquent testimony before the United States House Committee on Science and Astronautics by Dr. James R. Killian, Chairman of the Corporation of the Massachusetts Institute of Technology. On August 11, 1970, he said:

> "There is great need and opportunity for engineers who can build bridges between the sciences and engineering, and between the humanities and social sciences on the one hand and technology on the other. The engineer should be skilled in multidisciplinary methods, and, deeply interfused with his mastery of technology, should be a sensitivity to human and aesthetic values. I think the need for this kind of engineer, and the kind of technology he will create, should receive special emphasis in science policy."

He went on to add the following perspective on some of the new challenges of the 1970's:

"... the United States ... is ... moving into a position of world leadership in this whole field of environmental quality. The fact that somehow this country has come to identify the issues and to begin to tackle these issues, is having a worldwide impact today. And this drives directly at your strong feeling, which I share, that we must be concerned with the total human family."

The "new look" in engineering is likely to have a "new appeal" for women.

Let me illustrate the new "earth" challenge with reference to a problem which is intimately involved with the decisions made by women. Prior to 1946, almost all washing, whether it be buildings, clothes or skin, was done with some kind of soap. But in 1946, housewives were given an option—detergents. They gave detergents overwhelming preference. By 1965, however, it was learned that the inorganic phosphates which formed the basis of the detergents were not biodegradable. The result: pollution of water resources. Engineering and technology had brought about an improvement, but also brought a new problem, pollution. So now the search is on for a substitute for detergents that substituted for soap. Again, the answer must be found in science and engineering. And what are the requirements of this new search?[5]

First, it must wash well. Affluent consumers today are sophisticated. They have demanding tastes.

Second, it must be safe for contact with people.

Third, it must not be toxic to fish or other organisms in their food chain.

Fourth, it must be biodegradable, not stimulatory to algae and other undesirable plant life.

Fifth, it must be based on raw materials that are abundant, in order to provide the enormous tonnages required for mass consumption.

Sixth, it must be cheap to produce and process for it must be within reach of low as well as high income families.

This is an "earth," "people's problem." Women engineers should find the search as exciting and challenging as men, perhaps more so.

Another factor of change in the 1970's is the likely alteration in weekly work schedules. More experimentation has taken place in the work week in the last 24 months than in the last 25 years. Many firms are experimenting with four day work weeks and even three day work weeks. The reasons for this need not concern us here. And the movement may soon reach a peak and then decline. The evidence so far, however, suggests continued experimentation.[6] Should a very large firm or industry establish a breakthrough, the shortened work week might spread rapidly not only in manufacturing but in service and professional organizations. The implications for women are considerable. The short or flexible work week would add one more positive factor in facilitating the combining of home responsibilities and job.

Finally, I should like to suggest that the status symbols about high level careers for women have changed. Our studies of women's work at the turn of the century support the symbol that married women should not work. Let me illustrate with a hypothetical case. Three men in the office are talking in 1910:

A: "Did you hear about Harry? His wife had to go to work."

B: "Why that's terrible. The poor woman will have to drop out of church and all her clubs."

C: "How could that happen? Why?"

A: "I hear Harry is an alcoholic—he is drinking up all his money—I sure feel sorry for Harry's wife."

The status symbol of an up and coming executive was that he could say with pride that his wife didn't have to work for pay. He could support her adequately. If he could afford a domestic he really had the status symbol made.

Now consider the same scene in 1971. Same three guys are talking:

A: "Did you hear the latest—Harry's wife isn't working any more?"

B: "No kidding, how come?"

C: "Yeah, how could that happen?"

A: "Well, the rumor is that she has become alcoholic, nobody will hire her."

B: "I sure feel sorry for Harry—with his wife not working he won't be able to spend the summer in Europe. Poor guy—he may have to drop some of his club memberships."

The status symbols have changed. There is abundant research available which points to the fact that the higher the education of the husband, the more tolerant he is of his wife's working. Maybe in the future he will *insist* upon her working.[7] This just could be the counterpart of the "feminine mystique." In this case, some unkind critics have referred to it as the "masculine mistake."

V. What about the Paraprofessional Revolution?

The development of new high level interdisciplinary professions, as medical engineer, hospital engineer, biomathematician, radiobiologist, has been accompanied by the expansion in old, and the development of new, paraprofessional occupations. These include instrument technician, medical engineering technician, radiological technician, biomedical technician, chemical technician, mechanical engineering technician, etc.[8]

What role will these expanding paraprofessional occupations in science and engineering play in the career planning of talented women in the 1970's?

Some top women professionals have expressed misgivings about the fact that women now constitute a large majority of the paraprofessionals and presumably will continue to do so in the future. Their misgivings are several. First, they point out that if women cannot go into teaching after four years of college, they may choose to acquire a new para-skill in two years and start working at that point thus depressing the overall educational attainments of women, vis-a-vis men.

Secondly, they point to the fact that the great need for talented women is at the top, not at lower levels of the occupational structure. Expanding demand for paraprofessionals could lead to a successful transition school-to-job, but it

could also lead to dead ends and relatively low level careers. It might intensify the underutilization of women workers, already extensive.[9]

Are these concerns justified? Perhaps so. There is another side to this coin, however.

Let us assume for the moment that most paraprofessionals do not become professionals. Need this be? Or could paraprofessional jobs be the first rungs on a professional ladder? Could paraprofessional experience be recognized and given credit, equivalent to formal study, thus shortening the time required to obtain a professional degree? The answer, based on recent experience with physician's assistants, suggests that it could be "yes" thus opening up new opportunities for women in the professions rather than closing them. This is a development which contains both negative and positive factors for women in science and technology. It is an area that needs continuing study by professional organizations oriented toward the greater utilization of women. That study should reveal many opportunities to emphasize the potentials of paraprofessional work for high talent women to make it pre-professional rather than an end to professional training.

VI. Some Proposals for Increasing the Role of Women in Engineering and Science and the Role of Engineering and Science in Society

There are many approaches to increasing the role of women in engineering and increasing the role of engineering in society. The following eight are suggestive for a modest beginning.

First, *Bridging the Communications Gap.*

It is well known from abundant research in the 1960's, that many talented women are turned away from science and engineering at the high school level, by negative attitudes of counselors and supported by parents.[10] There is a wide communications gap between the engineering profession and high school students. Junior engineering societies, career conferences and other means have been used to stimulate more interest among women. Their effects have been minimal.

Therefore it is self evident that some new instrument is urgently needed to bridge the gap. Assume for a moment, that high school counselors are suddenly convinced that talented women students should be encouraged rather than discouraged from taking courses in science, mathematics, physics in high school. What would they find in the way of adequate written materials with which to inform students and parents? The answer is: "very little." And what little written material is available is out of date and not written primarily for women.

This suggests that an important contribution could be made by the development of several in-depth monographs designed to inform high school women freshmen and sophomores about science and engineering.

One volume might well be a "What I Do as a Woman Engineer" report. We have so many outstanding, successful women engineers in industry, government and academia. They could answer the questions of talented high school girls if they would simply describe what they do, how they do it, the problems, the challenges, the rewards, yes, and the headaches. This volume desperately needs to be written—by those who can do it best—women engineers.

A companion volume also needs to be written. It might be called "Why Science and Engineering are Necessary to Solve Our Social Problems." Such a volume written by women scientists and engineers might go far in offsetting the recent wave of anti-science and anti-technology literature presented so often by the news media and the "Future Shock" type of alarmist literature. It is disturbing that an entire generation of youth is growing up anti-establishment,

fed analyses that are superficial and naive but damaging. The answers to the social and environmental problems of an affluent society must necessarily come from science and technology, not from journalists trying to make an extra fast buck by selling scare stories. Those who believe in the fundamental rightness of technology in solving problems must say so. They must counterattack. They must reach the oncoming generation.

A third report might well be aimed directly at the nation's high school counselors where so much damage is done. This volume might be entitled: "Stop Turning Women Off," or "Quit Throwing Away Half the Nation's Brains." It would call their attention to the "new" look in science and engineering and the fact that many of the old barriers against women are down and the rest are coming down. Perhaps some of the poor advice given by high school counselors is not entirely their fault. Perhaps some of the blame must be shared by those in the technology professions who have observed the communications gap but haven't provided counselors with the right materials with which to bridge it.

Second, *Encouragement and Promotion of College Career-Alert Programs.*

With poor advice from home and high school, many talented women are going to enter college in the 1970's, unaware of two fundamental facts. One, that many of them will work much of their lives. Two, that drifting through college, taking courses that seem somewhat interesting and "relevant" but not related to post college careers, is likely to result in frustration and disappointment. The days of "it doesn't make any difference," as in the 1960's, are gone.

Every higher institution should give serious consideration to a career-alert program calling attention to the need for career planning by women. Science and engineering should be prepared not only to participate, but to lead in this development on college campuses. The development of new written materials as suggested in one, above, would support this leadership.[11]

Third, *Closing the Occupational Information Gap in the Expanding Sciences and Technologies.*

There is a serious gap, currently, in our knowledge of job opportunities and job characteristics in the newly developing technology disciplines at both the professional and paraprofessional levels. This gap arises from the fact that our three traditional means of gathering manpower information, i.e., establishment reporting, household enumeration, and administrative statistics, are not well adapted to new occupational developments.

For example: What are the opportunities in medical engineering? Where are they found? What are the changing education requirements? These and similar questions are hard to answer. We have no national statistical techniques designed to measure them just as until recently we had no continuing data on job vacancies.

There is need to close this gap. It could be closed by federal statistical agencies, as the National Science Foundation or the United States Bureau of Labor Statistics. Professional societies and professional conferences, such as this one, might well go on record as urging the development of new statistical series to close the gap. Closing it is particularly important for women, who need to learn about new challenging careers in science and engineering before it is too late to obtain the basic requirements.

Fourth, *Summer Engineering and Try-Out Internship Jobs in Industry and Government.*

One very important technique for resolving indecision about any professional field as a career, for both men and women, is the opportunity to work in the field or at least near enough to observe it first hand. This is particularly important for women who must overcome not only their own

lingering doubts but the advice of friends and relatives. Such opportunities are unfortunately, all too rare.

One of the outstanding women graduates in engineering from my institution, the University of Illinois, is Betty Lou Bailey. She graduated with a degree in mechanical engineering in 1950. Twelve years later after establishing a substantial reputation as an engineer, she was asked to come back to the campus to talk to the members of the local SWE chapter. In her very perceptive talk, "Woman Can Be Engineers," she pointed out the hurdles she had to overcome, the usual discouragement of friends, relatives. At the end of her junior year, despite high grades, she was still in doubt. But then she had an unexpected opportunity to work in the engieering laboratory of the Holley Carburetor Company, during the summer. She took it. That did it. She found out she could do engineering work. She found out she enjoyed the work immensely. The company confirmed her ability to perform well.

If industry and government are really serious about providing equal job opportunities, they should be equally serious about providing tryout and work experience.

The JOBS (Job Opportunities in the Business Sector) program of the business community to hire the disadvantaged has not accomplished everything, but it has accomplished much.

We need a parallel summer program for women in science and engineering. Women have been disadvantaged too. We might modify the familiar acronym SWE to read SOWE—Summer Opportunities for Women in Engineering. Such a program would give industry and government more experience with talented women and young women would gain meaningful insight into engineering that would help resolve doubts. We need more Betty Lou Baileys. And would-be Betty Lou Baileys need more try-out opportunities.

Fifth, *The Need for More Part-Time Professional Job Opportunities.*

Professional societies, especially those with a special interest in women, need to urge the development of more part-time opportunities for women in science, medicine and engineering. If we are to encourage talented women to combine marriage and professional work, then we should make this more feasible over the life cycle by facilitating the combination via part-time opportunities.

This subject has been talked about in the literature for the past 25 years. The fact remains, little has been done about it. There is need for several business firms and government agencies to take the lead with demonstration programs which could then be used as guidelines for other organizations. This could be a major project for the Sixth recommendation which follows:

Sixth, *The Need for Top Level Women's Professional Societies to Form an Inter-Society Working Committee.*

Women's professional organizations have done much to pull down barriers to the participation of women in science and technology. But working individually certain common tasks simply get left undone or done only partially. Collectively, these organizations might be much more effective. Included in such a top level organization would be:

Society of Women Engineers
American Medical Women's Association
Association of American Women Dentists
Society of Women Geographers
Woman's Auxiliary of the American Society of Mechanical Engineers
American Association of University Women
Association of Women in Architecture
Women's Veterinary Medical Association

A joint action committee might well want to promote some of the needs cited above. It certainly would want to promote suggestion number seven which follows.

Seven, *Income Tax Reform.*

It has long been recognized that one of the major factors limiting the return of professional wives to employment, after time out for children, is the inability to deduct fully from joint income tax returns for the added household expense. Our present tax laws are essentially a carryover from the days when very few women worked and if they did work it was at very low levels.

As a result of the rising participation of men and women in the ever lengthening educational stream we have a selective marriage pattern. Likes tend to marry likes. High school graduate men tend to marry high school graduate girls. College men tend to marry college women. And graduate students tend to marry graduate students. The result: most professional women tend to marry professional men. For example, a recent study of women dentists found that 75 percent were married to men who were also dentists or in other professions.[12] The same has been found true of women physicians and women engineers.[13] This means that such families are in a relatively high income tax bracket with just one spouse working. If both work the income tax take can be formidable. It sometimes doesn't pay for the wife to work. If she does work professionally because she enjoys it, she is working for nothing in economic terms. This is a gross inequity that needs correcting. It should be high on the priority list for any inter-society committee.

Eight, *The Need for a Single Federal Office Concerned Solely With the Problems of Women in Science and Technology.*

There are numerous government committees and agencies with responsibilities for equal rights opportunities, including those by sex. There is the President's Interdepartmental Committee on the Status of Women, the Women's Bureau, and others. The fact remains, there is no single office concerned with the special problems of women in science and technology. Equal rights legislation is all well and good, but it is also irrelevant if there are no qualified women even applying for professional jobs in science and technology.

It would appear at the moment, that the National Science Foundation will be the primary federal agency in this field. Hopefully in the future some of the drastic cuts in R and D expenditures formerly allocated by DOD will be restored and presumably given to NSF.

This Conference might well go on record as recommending to NSF, two steps. One, the creation of at least one high level position in NSF with sole responsibility for monitoring the role of women in science and technology and undertaking the research needed to supplement this monitoring. Second, would be the appointment of a National Advisory Committee on Women in Science and Technology to advise this newly created office on research and policy needs. If such steps could reduce the fragmentation of effort, now characteristic of endeavors in this field, and focus energies on selected goals, the contribution might be substantial.

VII. A Brief Summing Up

The present finds us in a stage of transition on many fronts.

Talented women can no longer drift through higher education. The easy days of the 1960's are gone. They are not likely to return. Women who seek part-time or full-time careers will have to do much more personal planning in the 1970's. It is reasonable to assume they will do so. In so doing they are going to look into the opportunities in engineering and science as never before. An

important contribution can be made by this conference, if it can take steps to assist in this search.

Engineering and the sciences are also in transition. They are taking on a "new look" which should have "new appeal" to all youth, and especially to women. It is urgent that we restore the confidence and interest of the oncoming generation in science and technology. Without the dedicated efforts of engineers and scientists there will be no way to solve the environmental and social problems which we all see before us. This may call for the re-education of the public. To the extent that this conference can assist in this re-education it will have made an important contribution to "Bridging the Gap Between Technology and Society."

These two challenges call for the best efforts of all of us—in engineering, in the physical sciences, in the social sciences. The era that has just ended, despite all the public criticism, was a great era of achievement for science and technology in many directions. The era just beginning, despite all the current skepticism, can be even greater for both women and science—if we choose to make it so. The very fact that in the midst of so much skepticism and doubt a few dedicated people are willing to put aside their usual tasks and gather in a conference of this kind is, I submit, a good omen for the new era.

Footnotes

[1]*Science and Engineering Doctorate Supply and Utilization, 1968-80,* National Science Foundation, as cited in United States House, Committee on Science and Astronautics, 91st Congress, 2nd Session, Hearings, 1970, p. 262.

[2]The statistics in this section are adapted from the author's working paper, "Women's Higher Education and Work: Some Questions, Problems, Challenges for the 1970's," prepared for the University Committee on the Status of Women, University of Illinois, April, 1971.

[3]University of North Carolina Press, Chapel Hill, 1957, 294 pp.

[4]For a discussion of the emerging medical-engineering discipline see e.g., James E. Payne, "Birth of a Giant: Biomedical Engineering," *Steelways,* May-June, 1965, pp. 19-23; John Plater, "Careers in Biomedical Engineering," *Occupational Outlook Quarterly,* Winter 1970, pp. 27-30; Edward Fox, "Engineering in Medicine: A Melding of the Professions," *Engineer,* January-February, 1970, pp. 13-16; *New Careers in the Health Sciences: Biology, Physics, Chemistry, Mathematics, Engineering.* The National Health Council, New York, 1961, 24 pp; Eugene Guccione, "Biomedical Engineering," *Chemical Engineering,* January 30, 1967; David D. Rutstein and Murray Eden, *Engineering and Living Systems: Interfaces and Opportunities,* M.I.T. Press, 1970, 320 pp.

[5]Adapted from a talk by Dr. Harvey Alter, The Gillette Company Research Institute, at the United States Department of Agriculture, National Agricultural Outlook Conference, Washington, D.C., February 23, 1971 and cited in *Family Economic Review,* June 1971, pp. 7-9.

[6]See, Riva Poor, *4 Days, 40 Hours.*

[7]Alice S. Rossi, "Barriers to the Career Choice of Engineering, Medicine, or Science Among American Women," in *Women and the Scientific Profession,* (J.A. Mattfield and C. Van Aken, eds.) M.I.T. Press; Carolyn Cummings Perrucci, "Minority Status and the Pursuit of Professional Careers: Women in Science and Engineering," *Social Forces,* Vol. 49, No. 2, December 1970, pp. 246-259; "Married Women in the Labor Force," by George Katona, Burkhard Strumpel and Ernest Zahn, Ch. 10, in *Aspirations and Affluence: Comparative Studies in the United States and Western Europe,* McGraw-Hill, New York, 1971, pp. 135-144.

[8]See, e.g., *Technician Manpower 1966-80,* United States Department of Labor, Bulletin 1639, March 1970, 28 pp; *Engineering Technicians,* (Walter J. Brocking, ed.) J.G. Ferguson Publishing Company, Chicago, 1969.

[9]*Underutilization of Women Workers,* Women's Bureau, Workplace Standards Administration, United States Department of Labor, 1971, 25 pp.

[10]"Women Scientists," in *Careers for the Seventies,* (Jerrold K. Footlick, ed.) Dow Jones Books, Princeton, New Jersey, 1969, pp. 201-211.

[11]See, e.g., *Women in Industry. New Perspectives from Education, Industry, Government.* Highlights of Conference, Mary Baldwin College, Industrial Relations Department, National Association of Manufacturers, New York, 1971, 96 pp.

[12]Erwin L. Linn, "Women Dentists: Career and Family," *Social Problems* Vol. 18, No. 3, Winter, 1971, pp. 393-404.

[13]Carol S. Shapiro, Barbara-Jean Sibler, Audrey A. Zelkovic and Judith S. Mausner, "Careers of Women Physicians: A Survey of Women Graduates of Seven Medical Schools, 1945-1951," *Journal of Medical Education,* Vol. 45, October 1968, pp. 1033-1040.

John B. Parrish

John B. Parrish attended the University of Illinois where he received the A.B. degree in 1934 and the Ph.D. degree in 1938. As a labor economist he has had extensive experience in government service, teaching and consulting.

Dr. Parrish served as Assistant Supervisor of Research, United States Employment Service, Occupational Research Project in 1938-1939, Assistant Professor of Economics, Southern Illinois University from 1939 to 1942, Senior Economist, War Manpower Commission in 1942-1943, Principal Economist, Assistant to the Director, Wage Stabilization Division, National War Labor Board from 1942 to 1944, and Regional Director, United States Bureau of Labor Statistics from 1944 to 1947. In 1947 he joined the University of Illinois and has been teaching there as Professor of Economics since 1955.

Professor Parrish is a member of the American Economic Association, Midwest Economic Association, and the National Defense Executive Reserve. He has been awarded Phi Beta Kappa, Kappa Zeta Psi, Phi Eta Sigma and has been a Ford Foundation Fellow. In 1968 he won an award for Outstanding Achievement in the Social Services from Pi Gamma Mu.

Professor Parrish has published an extensive number of articles and studies and has been one of the very few outstanding economists to devote continuing attention to the study of the employment of women in the professions, with special emphasis on women in the sciences and engineering.

Women in Engineering—Bridging the Gap Between Engineering and Society

Elizabeth Duncan Koontz,* Director
Women's Bureau, United States Department of Labor

It is indeed gratifying that the Engineering Foundation has teamed up with the Society of Women Engineers for the Foundation's annual conference on issues of concern to engineers from many disciplines. Your Conference theme "Women in Engineering—Bridging the Gap Between Technology and Science" is both timely and urgent. It is also gratifying that you plan to publish the findings of this 5-day conference. As will be apparent from my remarks, a wide variety of resource materials is needed; so the report and findings of this Conference should provide a reservoir of fresh, new material on which we can all draw.

There may be those who will question a conference to discuss ways of attracting a large segment of the population hitherto largely excluded—often self-excluded—*into* the engineering profession. Newspapers and magazines are replete with reports of the high incidence of unemployment among engineers and engineering technicians. However, this unemployment is limited largely to the aerospace field—one of the smallest specialties in the engineering profession, employing only about 65,00 engineers of the more than 1 million employed. According to the Bureau of Labor Statistics, the engineering fields for which the most "rapid growth" is predicted for the 1970's are also those which employ the largest numbers of engineers *and* those which are the most "natural," if you will, for women. These are: electrical engineering, mechanical engineering, and industrial engineering. This last branch of engineering is concerned, as the Bureau of Labor Statistics puts it, with "bringing together people and things." Now, isn't *that* what women do all their lives? Together, these three branches of the profession constitute slightly more than half (565,000) of all employed engineers. So don't let anyone "put you down" in your effort to encourage girls to become engineers, encourage engineering schools to admit them, and encourage employers to employ them. There is no anticipated surplus of engineers for the long run. In fact, it's quite the contrary.

I need not remind you that slightly less than 1 percent of all engineers in the United States are women. In the Federal service, the picture is even worse. Of the more than 81,000 engineers employed by the Federal Government, only four-tenths of 1 percent (.4 percent) are women—363 in all. Recently the Government established a very large program under the Occupational Health and Safety Administration, responsible for making and maintaining health and safety standards in the workplace. But only 10 women throughout the country were employed in 1969 as safety engineers by the Federal Government and 4 as sanitary engineers—since we have an "affirmative action program" and the Administration really means business about equal employment opportunities without regard to sex, strenuous efforts have been made to secure women safety and sanitary engineers. But they just aren't there!

We have just received a letter from the United States Atomic Energy Commission stating that it plans to increase its career professional staff by about 75 persons in the middle and upper experience level. They are particularly concerned to locate people who will work in the fields of the peaceful uses of atomic energy, the increased production of power to meet energy requirements

*Mrs. Koontz was named Deputy Assistant Secretary of Labor in March, 1972. She will also continue as Director of the Women's Bureau.

of the economy, technical requirements in the interest of public health and safety, and environmental and pollution matters. The letter states: "We are extremely interested in receiving applications from *all* persons who have the necessary knowledge and skill" and want particularly to insure that "the minority community is aware of these needs." If any of you are personally interested, and especially if you know other qualified scientists or engineers, particularly from minority or ethnic groups, please have them send their credentials directly to the United States Atomic Energy Comr ission, Washington, D.C. 20545. Please also send a copy addressed to me at the Women's Bureau.

It is significant to note that the enrollment of women in engineering courses is still pitifully small. According to the Engineering Manpower Commission, in the class that entered engineering school in 1969, only 1.5 percent were women—less than 1,200 (1,181) out of a freshman class of over 74,000 (74,113). The total number of women in undergraduate engineering courses was only 1 percent of all students so enrolled. When you allow for the normal attrition between undergraduate majors and ultimate employment in the profession, and when you allow for the normal attrition among those already practicing in the profession, it does not appear likely that the proportion of women to men engineers will increase significantly in the near future—unless a much broader and a more intensive campaign is mounted.

Before making program suggestions for such a campaign, I want to point out that there are many specialties in the engineering profession where women engineers may very well have a *special* contribution to make. Women are probably the largest users of the products produced by engineering skill and know-how. Consider our most glaring 'future' needs—areas such as the location, design, and equipment of day care centers for one. Another involves traffic and transportation. Who is going to unravel our traffic mess? Women haul their husbands to work and their children to doctors, dentists, music lessons; they drive to the market. Thirty million women work and must get to and from work. We make jokes about women drivers, but if some women engineers had been involved in the construction of highways and traffic signals and a lot of other things, perhaps we might not have needed to change things over every 2 years or so.

Consider the whole arena of the handicapped and what engineers have to do with that. I can recall that when I was responsible for a school program for handicapped children, the chairman of the Advisory Committee on Special Education was an engineer. A lot of people wondered why on earth special education teachers should be subject to decisions made by an engineer or someone who was advised by an engineer. They came to realize that in special education we have not only the mentally retarded but also the handicapped: the polio victim, the cerebral palsied child, the deaf, the amputees, and many others who need engineers to figure out how best to accommodate their shortcomings and deficiencies. Now, when it's dealing with the hardware like a wheelchair, we can see the need of an engineer; but when we look at all the new areas of concern: urban planning, homes for the elderly, hospitals—and I could go on citing the big demand fields—we ofttimes fail to realize that they are also areas where women's interests have been clearly evidenced and their know-how could be particularly pertinent to the efficient and creative meeting of the needs.

I have indicated that an intensive campaign is needed to bridge this gap between demand and supply. I want to share with you some of my thinking about the elements of such a campaign, which I hope will be "grist for the mill" of your workshops.

As I see it, our campaign should begin very early in a girl's life and would involve *unbrainwashing*—exploding the myths. There must be direct approach to

parents, the very young girls, teachers (beginning with elementary school teachers), admissions officers of engineering schools, and employers. Here are some of my suggestions:

Let me say first that you have an especially tough job. It *is*, in fact a battle against abysmal ignorance about a profession. Mothers generally know what doctors do—but *engineers?* In dealing with parents, one major myth about engineering has to be eradicated. Parents usually see engineering as hard hat, dirty work, squirting oil, crawling through large sewer pipes—you get the picture. The truth is that in the large areas of engineering I have cited and where the greatest demand will be, most of the work is likely to be done at a desk or drawing board in an office. How do we get this across to the parents of girls in elementary school—and even younger—who still think girls should be "made of sugar and spice and all things nice?"

One avenue of approach is through the PTA. Get a woman engineer on the agenda of PTA meetings to explain what engineers really do, the contribution they make, the needs and the rewards. Get them out of their old habits of thinking about engineers *and* about their daughters. Use a woman engineer as the speaker—a role model, about which I shall have more to say later. You might start with an illustrated article in the PTA magazine ending with the suggestion that they write the Society of Women Engineers for a suggested speaker in their locality.

Another avenue leads to involving the national voluntary organizations working with girls and young women: especially the Girl Scouts, Camp Fire Girls, 4-H Clubs, Y-Teens, YWCA and others.

To illustrate the potential of these organizations I want to pinpoint the Girl Scouts. We recently had a conference with Miss Nancy Porter, the new, young, able national representative in Washington of the Girl Scouts of America. You know the Girl Scout program has been structured around badges. The National Program Department is responsible for the nationally adopted official badge program and would be receptive to working with you on an appropriate badge in the engineering field. Although the whole question of badges as incentives is under scrutiny by girls and leaders, the program is more "open ended" than this suggests. Each troop is responsible for a project called "My Own Badge." Recently a number of troops have developed what they call an Eco-Action Badge—based not on just cleaning up the stream or lake but *studying the watershed* and man's relationship to the total environment. Miss Porter told where they get a badge on auto transmission repair! She emphasized that in her recent extensive visits to troops the girls were saying: "Homemaking and camping are fine, but give us *more relevant* things—and *career-oriented*, please." I suspect the same is true of the girls in 4-H clubs who might be most interested in a program unit on agricultural engineering—a burgeoning field.

Another road to the "unbrainwashing" of parents, teachers, guidance counselors is, of course, through printed materials. Your help on our leaflet "Why Not Be an Engineer?" addressed to girls, was of great value, and the leaflet has been much in demand. We have distributed about 150,000 copies, mostly on request. But we need more materials. I would like to see the Society of Women Engineers and the Engineering Foundation collaborate with us in producing a picture book for little children—perhaps a coloring book showing the various ways in which women engineers work, how they solve intriguing problems (children love that). Since the main bent of a child's career probably starts at the mother's knee, this would become a part of the mother's thinking as it becomes part of the child's thinking. This coloring primer might be distributed in supermarkets as well as in many other places; for example, I think especially of the Young Wives Clubs and Mother's Day Out Clubs in the YWCA's numerous

suburban centers. It might become one of the "non-comic strips" that are part of our comic pages, much as "Rosie the Riveter" was in World War II.

There needs also to be a plan of serious but stimulating articles tailored specifically to different constituencies. This would include articles for the Personnel and Guidance Association journals, the vocational educational journals, elementary school teachers' publications, and secondary school teachers' journals.

Organizations composed of boys and men must not be omitted, for male approval is still a very decisive factor in career selection for girls and women.

To change the image of a whole profession, the best medium is TV, since in this case it's essential to reach not a selected few but millions at every age level. This, of course, takes know-how and money, and I shall have more to say about that later.

My next road toward the goal is of paramount importance. It concerns the use of role models. Recently we had a series of conferences across the country—conferences of business, industry, and union leaders concerned with how women could be moved into jobs hitherto labeled "for men only"—and how they could be moved up the ladder. At the Idaho conference, in response to a suggestion on how business can utilize its talented women, a banker mentioned that he had never before considered sending a female bank officer to be the bank's spokesman at a high school Career Day. He always thought about sending one or two men, never thinking about the psychological effect when appealing to girls to enter banking—although a very high proportion of bank employees are women.

Most girls and boys have never seen a woman engineer. Instead of always sending out the male engineer to Career Day, why not send a woman engineer so the youngsters (boys and girls) get the idea that engineering isn't all brawn or that the engineer is only the top white hat in the crew?

Another part as role model for the woman engineer to play is that of tutor to girls who are bright, show aptitude in science and math, and appear to have an interest. Such a tutor would have enthusiasm for the sciences, can share her own experiences—which tell more than a thousand tracts—and inevitably can make things a lot clearer on this one-to-one basis.

Another role for the woman engineer as a role model is that of enthusiastic educational guide-specialist, providing experiences for interested youngsters to visit engineering establishments and sites where they can see women engineers at work and learn what they really do on their jobs. This firsthand contact is of immeasurable educational value because it gets into the realm of *experience* where the emotions as well as the intellect become involved.

To move from the public campaign to another area of related service, I would make one other suggestion for your Association—or perhaps the Foundation. It is that more of your data provide a sex breakout. We do not know how women are distributed throughout the various engineering disciplines: electrical, civil, mechanical, aerospace, etc. The report from the 1969 National Engineers Register titled "A Profile of the Engineering Profession" is excellent—except that it virtually omits *sex* as part of the profile.

To increase significantly the proportion of women engineers requires money. You have to put your dollars where your heart is. To carry out the program I have suggested will require, perhaps, the acquisition of a media expert for your staff. I say "media expert" because I feel that in today's fast-moving world the picture—whether in print, on slides, or TV—must supplement the printed word. It may be possible through the Engineering Foundation and others to secure some funding. Also, corporations with large engineering staffs facing the necessity for "affirmative action" in the employment of women at professional and managerial levels may be willing to cooperate with both finances and

technical assistance. You have probably seen this recent advertisement from General Electric. The cost of that wasn't peanuts! Or the brochure I saw, produced and distributed by Duke Law School, which read, "Who wants women law students?" and on the inside, said "We do at Duke." They got them, too. At mid-term, they had some 55 applicants—more than they had for the whole year past. And with LSAT scores above 500!

I have deliberately pinpointed most of my suggestions to reaching the grassroots level. Too many programs and publications are of a professional, academic content that reaches only those who are already convinced—but unfortunately don't know what to do to change the "climate of ignorance." You might take a look at how the social work profession, through its National Council on Social Work Education, set about changing its image and attracting thousands of new recruits.

In conclusion, I want to emphasize that you could not have undertaken a more challenging and promising task. The search for new and creative ways women can use their abilities more fully—not just for self-fulfillment (important as that is) but to help provide the resources through which your action can realize more fully the great purpose of our Nation. The eradication of poverty; the elimination of slums, urban blight, and pollution throughout our land; the providing of decent housing and adequate, low-cost transportation—all of these goals cry out for engineers.

Statistics on the number of working women indicate that the challenge today is not "shall women work outside the home?" it is rather "*how* shall women work?" Shall it be at traditional, stereotyped occupations which are generally low-paid and offer little opportunity for advancement—whereas the gifted, trained woman in a less traditional occupation can make a truly significant contribution to herself, her family, her community, *and* our national well-being?

Finally, lest all these suggestions may seem to end up in the long run as a program of words and more words—spoken and written—let me remind you of Lord Byron's lines from *Don Juan*:

"But words are things, and a small drop of ink,
Falling like dew upon a thought, produces
That which makes thousands, perhaps millions, *think*." (Emphasis supplied)

Elizabeth Duncan Koontz

Elizabeth Duncan Koontz holds a B.A. degree in English and elementary education from Livingston College (1938) and a master's degree in elementary education from Atlanta University (1941). She has pursued additional graduate work at Columbia and Indiana Universities and training in special education for the mentally retarded at North Carolina College. She taught school in several cities in North Carolina, where she eventually concentrated on mentally retarded and disadvantaged children.

Mrs. Koontz is a former President of the National Education Association where she initiated the Conference on Critical Issues in Education and efforts to eliminate discrimination in all forms against girls, women, minorities and the handicapped.

Since January 1961, Mrs. Koontz has been Director of the Women's Bureau, United States Department of Labor and also United States Delegate to the United Nations Commission on the Status of Women. She is the first Negro to be appointed to these offices.

Thirteen universities and colleges throughout the country have awarded Mrs. Koontz honorary doctorate degrees. In addition, she has been the recipient of several awards, including the Distinguished Alumni Medallion for Achievement from her almamater, Livingston College, the Distinguished Teacher Award from the Civitan Club of Salisbury, and the Distinguished Citizenship Award from the North Carolina Western District of Civitan Clubs International. She is an honorary member of Phi Beta Kappa, Zeta Phi Beta and Altrusa Club of Washington, D.C.; serves as an honorary chairman for the annual Ebony Fashion Show, Washington, D.C.; and is a consultant to the Committee on the Status of Women, National Council of Administrative Women in Education.

Mrs. Koontz has served as a member of many civic and professional organizations, including the North Carolina Association of Classroom Teachers (President, 1958-1962), the North Carolina Governor's Commission on the Status of Women (1962) and the President's Advisory Council on Education of Disadvantaged Children (1965-1968).

Improving Technology Transfer

Charles F. Horne
Chairman of the Board
Southern California Industry-Education Council

All engineers have something in common. One of the things they have in common is that to a degree they are able to talk to each other. And that's good. One of the big problems we face today in our society is the fact that our sociologists blame all of us technologists for all the troubles in the now-world. And, of course, we, as technologists, have a tendency to blame the sociologists for all of the troubles of the now-world. The real problem, of course, is that our sociologists simply don't understand engineers, engineering, science, technology or many of the things that we understand. And unfortunately not enough of us engineers can understand sociology.

I remember my father, who was a professor of English, telling me at an early age that his problem was he could not teach English to engineers. He tried, but he had a lot of trouble. So when I came to the point that I was an engineer myself, and then progressed to where I had the responsibility for hiring engineers, you might be surprised to know that, to the consternation of my industrial relations people, I insisted we hire only engineers who had a thorough grounding in the humanities. I was told this couldn't be done—that "an engineer is an engineer"—and we wanted the best engineers. "No," I said, "I want the most useful engineers—the most valuable engineers—and any engineer who can't communicate, in my opinion, is not nearly as valuable as an engineer who *can* communicate." Based on this program I was able to hire not only excellent women engineers, but excellent men engineers, too.

The members of the Society of Women Engineers are pretty good communicators, and I think this is one of the best things you can do.

Today Mrs. Koontz practically made my speech for me. I would like to say much of what she said, but now that she has said it I'll simply try to confine myself to a few words and then go on to something else you may be interested in.

The hope of our free world, the hope of our planet, with its greater and greater overcrowding, and all the difficulties we see around us, whether it is the environment, ecology, or the many other problems—the hope of this planet is that we will have more competent, not less competent engineers. And in my judgment the hope is that we will have more women engineers, for many of the reasons that Mrs. Koontz outlined today. When it comes to communicating with people—sociologists, non-technologists, etc —I have found that women engineers are better at it than men engineers. I am not trying to sell you anything. This is a research I did and I have found that, generally speaking, women engineers had better, more understandingly, utilized their knowledge for what I would call "engineering for the humanities," as distinct from engineering only for engineering's sake.

The important thing that is needed today is a catalytic agent that can get the right and the left and the middle, the women and the men, the minorities and the majorities, the Democrats and the Republicans and the independents to talk together, to work together, to try to understand each other and get some kind of agreement so that they can *do* things.

Mrs. Koontz gave us some pretty good ideas this afternoon on how we can work together to reach through lower grades of education in order to give the opportunities to young people to better understand about the world around

them, particularly the world of work. In elementary school today, children are simply not getting any sort of understanding of what the world of work is all about.

Now there are ways and means to remedy this. One is Industry-Education Councils. Some of you have heard of them. They exist in various places under various names. In California and Arizona we have what we call the Business, Industry and Education Councils. They operate at a local level, and then they usually have a general regional level at which plans can be made and things can be done to encourage the formation of other local councils and assistance can be given to those local councils in what they do.

Here is a case where industry actually works with education. Not one working for the other, but both on the same level working with each other. All of a sudden you find industrialists and educators communicating with each other. Of course they first start with each one telling the other that they don't really know what they are doing, and they aren't doing a very good job. After they have got that off their chest, then they start talking to each other and trying to understand each other, and the first thing you know they are helping each other.

Now, the basic purpose of the Industry-Education Council is to help the teacher reach and motivate the children. I think that is worth doing. I don't have to tell you that home is not what it used to be, and parents for one reason or another are not reaching and motivating their children as they once did.

You can blame it all on television. You can blame it all on electronics and technology—and you'd be partly right, because what we have to do is not only invent gadgets, but we have to pass the word on how to use the gadget for the benefit of humanity.

I think one of the ways to do this is by industry-education cooperation. Another way is to get this cooperation working at lower educational levels. Although many people have realized this is necessary, most people think of education as starting in college. But of course this is nonsense. By the time the child is ten, the major portion of his education has been completed. Sounds like heresy, but research indicated that the child learns more from six months to six years than from six years on in many, many important ways. The learning is not that of the facts and figures we engineers learn in college, but of all sorts of terribly important things, including some understanding of what it is all about and how to get along with people. These things have to be presented to the child before he reaches the eleventh grade.

Now this is a tough job and industry is trying to help. "Fine," you say, "so industry wants to help education reach and motivate the children. How, then, do you motivate children?" I don't know, but I know this: When you put unmotivated children in close physical, spiritual and mental companionship with motivated adults, believe me such an experience proves that 85 percent of the time you get motivated children as a result of that proximity. Now this means that 15 percent of the time you get frustrated adults. But that doesn't bother them, because remember we started with motivated adults, and motivated adults can withstand frustration. Unmotivated children cannot withstand frustration. That's why we have to find a way to reach and motivate the children, not just to be engineers, not just to be machinists, not just to be lawyers or doctors or professionals or occupational workers, or whatever. We must reach them and motivate them to be whatever their own interests, understanding and ability show them that they want to be. We want to give them the opportunity to understand the world well enough to understand what they really want to do with their lives—what businesses they are interested enough in to work at, and have fun doing it. If we can get that across to them, then we have succeeded. Because a motivated youngster can do anything and does. An unmotivated

youngster goes round and round and finally society, or parents, or somebody pushes that unmotivated youngster into college.

Then college defeats that youngster and the youngster wants to burn it down, because anyone who has been defeated by anything feels a very grave frustration and anger at whatever defeated him. It is not easy for most people to be defeated. That is one of our big problems. Unmotivated people can easily be defeated. Highly motivated people cannot. How then do we avoid the frustration—the defeat—of the youngsters?

I call your attention to the American Institute of Industrial Arts. It has a national organization and regional organizations. It is rather unique because it is not trying to teach English, Spanish, mathematics. It is trying to get youngsters to understand the various methods, procedures and systems of industry. This is done by specific courses in industrial arts, and some of it is done by putting industrial arts ideas into the heads of teachers who are teaching a course. That is even better sometimes than having specific courses.

The net result of all this is that if industrial arts does a good job, all the teachers benefit and all the kids benefit. But industrial arts can not do all of this by itself. They have to be helped by industry. It takes time, attention, advice and assistance. When this is done there is an opportunity for this understanding which can lead to the technology transfer.

Technology transfer offers real hope for needed employment. In the unemployment situation, at first everybody said, "Let's get lists of people and lists of jobs and put them together and that will solve the problem." But it didn't. We have lists of people. When you try to get lists of jobs, the jobs aren't there. The only way that the needed jobs that aren't there can be created is by bringing about an understanding of the real needs of our society. There is a lot of talk about improving our environment, about ecology and so forth, but when we get down to what are we doing to do about it, there actually is no program or understanding about what can be done about it and how much it is going to cost to do it. So there is no money and there are no jobs to help the environment or the ecology. It seems to me we have a problem in getting non-defense and government to understand that engineers are urgently needed by non-defense and government, even more than they were needed by aerospace.

I have here a publication called *Aerospace*. It says "Society and Aerospace Technology." One of the articles is entitled "Doubts about Technology. Are They Valid?" The next one says: "Question—Can Aerospace Technology Serve Non-Aerospace Needs?" then: "Fact—Transfer Aerospace Technology is Underway." And it is. NASA is trying very hard to effect the transfer of technology from aerospace, defense, all kinds of things, into non-defense, cities, states, counties, urban problems, model cities and so on.

I don't know of any way that we can control our environment to satisfy our population unless it is done by some of this technology transfer, and I think that engineers can do it better than people who don't understand or aren't interested in what we are trying to do.

Now let us go back for just a minute to the Industry-Education Councils. They have many different programs and work with many other groups who have similar ideas. You have all heard of Junior Achievement. Junior Achievement is good stuff, but it's not as widespread as it should be. You may have heard of the Council on Economic Education, and that's not as widespread as it should be. But if you put all these together you have the basic principle and the basic idea of industry-education cooperation, whatever title you may put on it.

The Southern California Council was started because the President's Commission on Manpower, the National Science Foundation, and the National Academy of Science, in 1956, decided there weren't enough engineers in this

country. There had to be more. How did you reach and motivate children to become engineers?

We were so successful with this project in California that we spread not to just motivating youngsters to become engineers, but to motivating them to become whatever they thought they could be, successfully and with enthusiasm and would enjoy. This has worked pretty well.

I might mention that all of the Science Fairs in California are organized and run by the Industry-Education Council. We have conferences between education and industry, and we furnish assistant counselors to education. Of course we all know that there is not enough money or time to have enough counselors so that there can be real person-to-person discussions between the counselor and the child at the proper time, or in sufficient volume to have a good influence on the child. But if you have a counselor, and then supplement his work with an assistant counselor, furnished part time by industry, you'd be surprised what you can do on a person-to-person basis.

I think most of you agree that to reach people you have to do it on a person-to-person basis. That is the only way I know that you effectively get through to children. Many times I have asked adults: "How did you get motivated?" In answer, almost invariably, after some thought, the adult will say: "Well, you know I had a teacher . . ." And they will give you the name and the description of that teacher and explain how that teacher reached them. Sometimes a parent reached them, sometimes an aunt or uncle, sometimes a minister or a Scoutmaster. But 60 percent of the time, in my actual personal experience in questioning adults, it has been a teacher that they remember as having reached through to them and somehow motivated them to want to do whatever it was they decided to go on and do. It seems to me that this is very important.

How, then, can your organization participate in technology transfer, and how can it participate in working with industry to help reach the children. Most of you are in industry, so most of you can encourage your industrial organization to participate in and work with education to help reach and motivate the children. Those of you who are in education can help to encourage this sort of participation, and all of you can certainly help a lot, if you want to, in this basic principle of technology transfer. Now it seems to me that if we can, by understanding these problems, and encouraging more people to be what they really want to be and can be, we will get more engineers and technologists of the kind that we need, and this will bridge the gap between technology and society because only then can we really get the job done.

There is an old naval schooner rule of the road which is well known to people who go to sea. It is not written anywhere. Anyone who has been to sea for any length of time learns all the standard rules that are written down—but this rule is the unwritten rule of the road for all seamen: "When in danger, or in doubt—run in circles, scream and shout."

Now there's a lot of that going on today. Running in circles, screaming and shouting, instead of really getting down to the fundamentals of what we are going to do. But a plan and a program are essential if we are really going to get anything done. So I suggest we change that old unwritten rule of the road to read: "When in danger, or in doubt—get together—work it out." Thank you.

Discussion

Question: What industry-education activity is there now organized in Illinois?

Answer: Practically none, so I was told by the Illinois people with whom I spent the first two days of this week at Stout State University in Wisconsin. We had

considerable discussion about this whole matter of technology transfer with industrialists, industrial arts people and people state-wide. They were absolutely amazed and could not come up with any comparable organization to the Industry-Education Council. That is why we have formed the Industry–Education Council of America, so that all over this country we can come up with something whereby Industry and Education can understand each other and work together.

Question: Are there Councils on the East Coast?

Answer: New Jersey has an organization, but I'm not sure what the name of it is. It is trying to do the same sort of thing that we are trying to do. There are other small organizations in some cities, but I have not found state-wide organizations trying to do what ours is doing.

Question: How do you encourage people to become motivated?

Answer: This is the problem. There is a difference between spectators and participators. Now I believe that engineers are participators, but the average person is a spectator and doesn't even want to participate. Don't ask me why. I do not know, because I am a participator. Engineers have the tendency and the desire to be participators and not just spectators.

Question: How should women engineers show their willingness to accept the responsibility for encouraging young women to enter the field of engineering?

Answer: Work with the educators to motivate young women to go into industry and engineering. As Mrs. Koontz said today either you reach the parents or you reach the teachers. They are the only ones who can reach the children in time to motivate them to want to be an engineer, a technologist, a professional or an occupational worker.

It is important that occupational vocational education be recognized as being for first class citizens, not for third class citizens, which it is today. How do we convince parents, society, and all the people who need to listen, that young people who want occupational vocational training should be considered first class citizens? It's fun to work with your hands. The most fun a man can have is when he can have the brain and the hands working together. My father, a college professor, taught me how to be a good carpenter and a good plumber. From that I became a radio and electronics technician and built all my own radio equipment. And then I became an engineer.

Question: Regarding unemployment, what is being done in California by the various commissions in regard to unemployment and how does the Western engineering picture dovetail with the unemployment problem?

Answer: On a national, as well as a California, basis there are large numbers of unemployed engineers. In regard to aerospace, the national policy was not properly thought through in advance, and a good planned program was not made for the change in national policy until the change in national policy went into effect. As a result, all of a sudden, national defense, aerospace, and allied engineering organizations went kerplunk—and some of them went only half way down, of course. Because of this there are at the moment, temporarily, more engineering people than there are engineering jobs. I have reason to know this and have the facts and figures to back it up. You remember I said it was a temporary situation. Actually there is such an urgent need for more and better

engineers in non-defense that our task is to define the ecological problems, the city problems, the ghetto problems, the urban problems—all of the problems that confront us. We have to define these problems and show what the problem is—and then we have to show a solution. When that is done we have to get the money to implement the solution—and then we have the jobs.

In order to do this we have to change history. As an example: Mr. X, the President of Y Company, said to me: "I want no part of engineers—particularly aerospace engineers. Those people don't know what to do. They have been trained in such a highly specialized fashion that they are of no use to me at all. Furthermore, they are all paid far more than I can afford—much more than they are worth. Even if I did hire one, in six months he'd leave me and go back to aerospace." One way or another, by twisting his arm until it almost came off, I got him to hire two independent aerospace engineers. Six months later he was back asking for six more just like them. They were the greatest people he ever hired—communication . . . understanding. The problem is that non-defense industry right now is having trouble with products from overseas coming into our country and pushing our domestic product out of the market. How are they doing this? They are doing it by being more productive, having a better product . . . in various ways.

What we have to do is get our wonderful engineers and technologists into non-defense so that they can make the whole lash-up a better operation. Aerospace engineers, and engineers in general, have the feeling that nothing is impossible, even though it may take a little longer, and nothing can defeat them. But the non-engineers are easily defeated and consider a thing impossible unless it is written out so that they can thoroughly understand it. By getting the good, innovative engineering type people into non-defense, we can create the productivity, the growth which will bring us back into the world market, and give us the opportunity at the same time to improve our environment.

Charles F. Horne

Charles F. Horne graduated from the United States Naval Academy in 1926 and holds an M.S. degree in communications and electronics from Harvard University (1935).

Mr. Horne was one of the pioneers in the applications of electronic concepts in the United States Navy as commanding officer of the destroyer *Long*, 1940-1941 and, during World War II, as communications and radar officer, Battleships, Pacific Fleet; communications officer, South Pacific Area; communications and radar officer, Amphibious Forces, Pacific. He received several combat citations and campaign ribbons. From 1946 to 1948 he was Deputy Chief, Naval Communications. He is a Rear Admiral, United States Navy, retired.

On loan from the Navy to the Civil Aeronautics Administration in 1949-1950, Mr. Horne was Acting Director of the Federal Airways Division. Upon his Navy retirement in 1951, he served as Civil Aeronautics Administrator until 1953 and was also a member of the Presidential Airport Commission during 1952.

Mr. Horne joined the Convair Division of General Dynamics Corporation in 1953, became a Convair vice president in 1957, then a General Dynamics vice president and president of the Pomona Division in 1961.

Since his retirement from General Dynamics Corporation in 1971, Mr. Horne has devoted himself to promoting closer cooperation between industry and education. To this end, he serves as Chairman of the Board of the Southern

California Industry Education Council, Chairman of the education committees for both the Los Angeles and California State Chamber of Commerce, Member of the Advisory Board of the Los Angeles International Science Center, Member of the Space Museum Advisory Committee and Member of the Board of Trustees of Claremont University Center. He is also President of the Coordinating Council for Higher Education in California and a member of the Board of Councilors, School of Engineering, University of Southern California.

Mr. Horne holds a number of awards, honorary offices and memberships in electronic and aeronautical societies.

Opportunities for Women Engineers in the Federal Service

Harold H. Leich
Chief, Policy Develcpment Division
Bureau of Policies and Standards
United States Civil Service Commission

Since I am not an engineer—nor a woman—I come to you as the expert from Washington to tell you all about women engineers in the Federal service! Seriously, I regret that Evelyn Harrison, who recently retired as Deputy Director of our Bureau of Policies and Standards, cannot be here in my place, since she began her Federal career as a young engineering graduate and progressed to a high policy-development post. Her advancement illustrates how the intelligence and analytical ability required in the engineering profession can also lead to success in administrative work.

My theme today is that women can and do find satisfying career opportunities in the Federal service as professional engineers but that additional steps are needed to enhance these opportunities. The actual numbers in our service are small, although in terms of their availability in the labor market we seem to attract our share. But before swamping you with statistics, let me sketch in the broader picture of the Federal service as an employer of women.

First of all, I think it is fair to say that the Federal Government today is a modern, progressive employer. We have always measured up well on such benefits as leave and retirement, although for decades we had the reputation of lagging behind on pay rates and insurance programs. But in the past ten years, through cooperative efforts of unions and management and the Executive and Legislative Branches, Federal pay has become comparable to that in American industry, and insurance and other benefits have improved as well.

Within this setting, what about opportunities for women in the ranks of the nation's largest civilian work force? Here we need to go back in history. Except for a few early postmasters, the employment of women in the Government began in the Treasury Department, which defied both tradition and propriety during the Civil War by hiring a number of "lady clerks." Their pay was limited to $600 a year, which was half the basic rate for men. Equal pay for equal work came in 1870, when Congress recognized women's value by giving agencies permission to pay them the same as men. Equal employment opportunity for women is also a long-standing principle of the Government, established in 1883 when the original Civil Service Act gave women and men the same rights to compete in examinations for appointment.

Admittedly, the enforcement of the Civil Service Act has not always been perfect, and the generous intentions of the 1870 law were distorted into a presumed authority for agencies to limit their hiring to one sex if they wished. Thus for many years women were excluded from consideration for many kinds of work and for almost all higher level positions. An Attorney General's Opinion of 1962 set aside that interpretation, and the Civil Service Commission immediately denied agencies the right to specify sex in filling all but a very few types of jobs. In 1965 Congress repealed the 1879 law, and just a few weeks ago the Commission took another important step by revoking a long-standing policy against certifying women candidates for law-enforcement jobs. So today agencies can obtain certification by sex only when the Commission agrees that such action is necessitated by the total work situation, as when separate sleeping

quarters for men and women are not provided, or when institutional services must be performed by a member of the same sex as the persons served.

Discrimination because of sex is prohibited within the Federal service, since 1967 when President Johnson amended his equal employment Executive order. In 1969 President Nixon fully incorporated the Federal Women's Program into the overall Equal Employment Opportunity Program. The Commission provides leadership to the program and evaluates progress within each department and agency. Let me cite just a few recent breakthroughs:

> Mrs. William Colley is the only woman supervisor of motor vehicle dispatchers in the Veterans Administration. Having direct supervision over light automotive equipment operators, she is responsible for the maintenance and operation of 19 vehicles used at the VA Hospital, Marion, Indiana.
>
> The Department of Agriculture has hired women to work in the forests planting trees, logging, and on slash (clean up) crews for the first time since World War II.
>
> The first woman tower chief has been selected by the Federal Aviation Agency. Miss Gene Dorothy Sims has been with the agency since 1956, served three years in the Marine Corps where she became a senior control tower operator, holds a private pilot rating, and is currently studying toward a law degree.
>
> Alice Chancellor, an electronics engineer at the United States Army Proving Grounds, Fort Huachuca, Arizona, has been named the Outstanding Handicapped Federal Employee of the Year. She began her Federal career as a stenographer but obtained an engineering degree despite a blood infection which led to the loss of both legs and the sight of one eye.
>
> In 1970 six women civilian scientists (five from Navy and one from the National Science Foundation) participated in research projects in Antarctica, enduring temperatures as low as 47 degrees below zero.

Another constructive step the Administration recently took was to encourage the establishment of part-time Federal positions, in order to help women with children come back into the work force.

"This is all very well," you may be thinking, "but what about women *engineers* in the Federal service?" So I see it is time to stop filibustering and get to the topic you assigned me, even at the cost of wallowing in some employment statistics.

I wish I could flood you with figures showing that Federal departments are employing eight or ten times the proportion of women engineers who work in private companies, but this is simply not so. We are doing our part, perhaps, but we are up against the same basic facts that I am sure you are discussing in your conference sessions. Just for clarity let's review them again:

> About 1 percent of engineering *students* today are women, but according to the Engineers' Joint Council less than ½ of 1 percent of all *graduated* engineers in this country are women.
>
> Our figures show that, out of 84,692 professional engineers in the Federal service, 421, or ½ of 1 percent, are women. So we are "even

Steven" with all other American employers of engineers—but, of course, we are not satisfied with that position.

The Women's Bureau, Department of Labor, estimates that the present number of women graduate engineers approximates 9800. If this figure is correct, then the Federal service employs a little over 4 percent of all American women engineers.

Career opportunities in the Federal service for competent and ambitious engineers are almost unlimited. The Department of Defense naturally employs the largest number. Other principal employers of engineers are the Departments of the Interior and Agriculture, the National Aeronautics and Space Administration, the Atomic Energy Commission, the Tennessee Valley Authority, the Federal Aviation Agency, the Veterans Administration, and the General Services Administration—and there are many more.

While some Federal agencies show dramatic increases percentagewise in the numbers of women in engineering, one soon learns not to heed percentages in measuring "how far the baby has come." Examples: The Arms Control and Disarmament Agency increased from 2 to 5 in 1969—an increase of 150 percent; better still, the Equal Employment Opportunity Commission has one engineer and since she is a woman, 100 percent of the agency's engineers are women!

In an attachment to this paper I am listing some detailed information about the 21 different occupations in the Engineering Occupational Group. (These include Landscape Architecture and Architecture, but they do not materially distort the totals for the strictly engineering occupations.) I will not belabor the statistics further except to point out that the table shows an annual intake of some 4000 new appointees into the Federal engineering occupations. This should be your "target for tomorrow"—with the objective of counseling young women who show interest and aptitude to prepare themselves to fill these future vacancies. Certainly they will find Federal recruiting and appointing officials receptive to their quest. Objective proof of this statement comes from the favorable figures on the employment of women in other Federal professions, such as mathematics and chemistry, as shown in the attached table.

One ideal mode of entry into professional engineering work in Federal agencies is through cooperative educational programs, and I need not explain the mechanics of such programs to this group. Federal departments have been active and successful participants in these programs for many decades. From the employer's viewpoint, the program offers a chance to capture the interest of students before their career directions are established, and to observe them in a work situation. From the student's viewpoint the program provides financial support and a ready transition from the campus to the working environment. A high percentage of students stay with their co-op employers after graduation. In three of the largest Federal agencies, over 67 percent of the graduating co-op students in shortage-category positions in 1969 became career employees in the same agencies.

In 1970 the Federal Government had some 4000 college students enrolled in its co-op programs, and about 3000 of these were in engineering and the sciences. Our best estimate is that about 1.5 percent of those in engineering were women. The Navy co-op program seems to be doing a lot better—of 822 enrolled, 32 or 3.9 percent are women. Of the total number in Navy, 68 percent are enrolled in mechanical or electrical engineering.

Finally, let me mention a route into professional engineering that we may not be using sufficiently—upward mobility from the technician ranks. Already on board in Federal agencies in late 1969 were 829 women serving as engineering technicians, 432 in engineering drafting, 84 electronics technicians, and 50

industrial engineering technicians. By their vocational choice these women, contrary to popular myths, have already demonstrated their liking for things mechanical.

Federal agencies are placing increased emphasis on upward mobility programs to open up career ladders for those who are stuck in the lower grade levels. Granted not every woman now serving in engineering drafting in a Federal agency has the motivation or ability to become a true professional engineer. But of some 1400 women now in technician type jobs, surely there are several hundred who would welcome the chance to show what they can do.

To insure success, a carefully designed program of counseling, in order to determine interest and aptitude, is needed. For those who are selected for the upward path, we already have full legal authority to pay for outside professional education, whether done on a part-time basis through evening classes or on a full-time basis for an academic year. We know it is unrealistic to expect conversion from technician to professional status through on-the-job experience alone, although this can mesh in nicely with formal academic education, just as it does in co-op programs.

Our civil-service job standards for professional engineers do not require completion of formal academic education, although the great bulk of applicants and employees have bachelor's degrees in the appropriate engineering speciality. Thus in our personnel system there are no artificial barriers of "credentialism" to hamper upward movement of technicians who have the opportunity and the drive to prepare themselves for professional work.

So far I have talked only about opportunities in the Federal service, which comprises some 2,900,000 civilians. A far greater opportunity for women engineers is opening up in our States, counties, and cities, which together employ more than 8 million workers. Their need for engineers is growing in such dynamic programs as those for highway design, traffic control, transportation planning, water works, and new sewerage systems and treatment plants. And with today's concern about the ecology of "Spaceship Earth," the professional challenge of these once-mundane activities is equal to any in outer space.

We do not look on State and local governments as our rivals in competing for a limited supply of engineering talent, whether male or female. Under the New Federalism we at the national level are in partnership with State and local governments to solve the great social and economic problems of our day. The 91st Congress, as one of its final achievements, enacted the Intergovernmental Personnel Act of 1970, and President Nixon signed it on the fifth day of 1971. This landmark act enables the Civil Service Commission to grant funds and other assistance to State and local governments for improving their personnel and training programs. One important feature of the IPA authorizes the detail or transfer of Federal professionals to State and local governments for up to two years, and a similar movement of State and local employees to Federal agencies. Here is a ready-made tool for enhancing professional development and interchanging techniques and experiences.

You will be interested to know that just a few days ago the President announced the initial appointments to positions on the Advisory Council on Intergovernmental Personnel Policy, a body established under the IPA to assist in its implementation. Both the Chairman and Vice Chairman are women who have distinguished themselves in public personnel administration: Mrs. Ersa H. Poston, who is President of the New York State Civil Service Commission, and Mrs. Barbara Gunderson, a former Vice Chairman of the United States Civil Service Commission. Mrs. Gunderson's present successor in the post of Vice Chairman of our Commission is Mrs. Jayne Baker Spain, who has long been concerned with industrial personnel issues and who serves as Vice Chairman of the President's Committee on Employment of the Handicapped.

Coming back again to my assigned topic of women engineers in Federal agencies, I have sketched in the picture of where we stand today. You may feel that the brevity of my account matches our lack of accomplishment on this subject. But removal of legal and other barriers within the Federal service and a positive attitude toward recruitment and advancement of women are not enough in themselves if sufficient numbers of women do not prepare themselves to take advantage of these opportunities.

Clearly a major effort must be made to change people's thinking and attitudes about suitable careers for women—and that is why your five-day conference on women in engineering is so promising. This is a challenge we can all accept—to help Womanpower take its rightful place in the shop, the laboratory, and the field engineering party.

And because the road to a professional degree is still a long one and time won't wait, I hope that within your powers you will encourage the career counseling of girls at the high school level. They—and their parents—should recognize and accept the new role of women in a new world, not as a burden but as a shining opportunity. And—by all means—in engineering, if that is what they want to do.

Data on Women in Selected Federal Occupations

Occupation	*Total Number*[1]	*Women*[1] *Number*	*%*	*Total Annual Intake from Outside (FY 1969)*[2]
1. Professional Engineering Occupations				
General Engineering	13862	44	0.3%	320
Safety Engineering	504	10	2.0	n.a.
Fire Prevent. Engineering	83	—	—	n.a.
Materials Engineering	861	13	1.5	n.a.
Landscape Architecture	544	8	1.5	n.a.
Architecture	1515	43	2.8	166
Civil Engineering	17412	61	0.4	570
Sanitary Engineering	957	4	0.4	n.a.
Mechanical Engineering	10646	43	0.4	733
Nuclear Engineering	1358	4	0.3	n.a.
Electrical Engineering	4589	14	0.3	413
Electronic Engineering	16353	64	0.4	951
Aerospace Engineering	9673	83	0.9	453
Naval Architecture	1244	7	0.6	47
Mining Engineering	459	—	—	n.a.
Petroleum Engineering	240	—	—	n.a.
Agricultural Engineering	600	2	0.3	n.a.
Ceramic Engineering	36	1	2.8	n.a.
Chemical Engineering	1390	12	0.9	109
Welding Engineering	92	—	—	n.a.
Industrial Engineering	2274	8	0.4	248
Total	84692	421	0.5%	(4010)

2. Some Other Professional Occupations (For Comparison)				
Accountant	20241	1409	7.0%	1098
Attorney	10172	634	6.2	695
Chemist	8248	1249	15.1	560
Computer Specialist	18596	4044	21.7	1022
Librarian	3447	2427	70.4	218
Mathematician	3553	789	22.2	536
Physicist	5700	159	2.8	658
Social Worker	2362	1129	47.8	626
Statistician	2248	456	20.3	150

[1]October 31, 1969, Occupational Survey of Full-Time White Collar Employment.

[2]*Current Federal Workforce Data* for FY 1969. Data are available only for those occupations covered by this report series.
n.a. = data not available.

Harold H. Leich

Harold H. Leich received a A.B. degree with honors in business administration from Dartmouth College in 1929 and in 1955 received an M.A. degree in public administration from American University.

He joined the Research Division of the United States Civil Service Commission in 1935, following several years of sales and contact experience with the Sunbeam Electric Manufacturing Company and the General Foods Sales Company. His assignments in the Commission have included service as Director of Personnel, Chief of the Standards Division and Assistant Director of the Bureau of Departmental Operations. His present assignment is Chief, Policy Development Division, Bureau of Policies and Standards. In 1963 he received the Commissioner's Award for Distinguished Service.

During World War II Mr. Leich served as Civilian Personnel Officer of the Bureau of Naval Personnel and as a deck officer on convoy escort duty.

Workshop I

How to Reduce the Gap Between Society and Technology

Chairman: George Bugliarello
Recorder: Lois Greenfield

Participants:

John D. Alden	Grace M. Hopper
Betty Lou Bailey	Ruth A. King
Sallie M. Barre	Bette A. Krenzer
C. Anne Bennetch	Marion Monet
Emmy Booy	Betty L. Pollak
Anogene DeVaney	Caroline Preece
Barbara Fox	Catherine H. Proctor
Lois B. Greenfield	Irene W. Sharpe
Jacqueline G. Gutwillig	Mary G. Sohler
Arminta J. Harness	Renee R. Stone

Workshop I was concerned with exploring information and issues that would provide general background for the program–action workshops that would follow. It had essentially two tasks:

1. To discuss the factors that are influencing the growing gap we currently perceive to exist between technological accomplishments and societal understanding of, and identification with, technology.
2. To determine how a broader involvement of women in engineering and in other technological activities can contribute to the reduction of such a gap.

I. Summary of Conclusions

A. The key factors that influence the gap include:

1. Educational experiences and environments that fail to convey information about technology or to provide motivation for the pursuit of technological careers.
2. The lack of an informed and balanced picture of technology and engineering and particularly the lack of an image of the involvement and potential of women as active participants in technological processes.
3. The presence of an existentialist shift among many of our youth who seem to prefer *to be*, rather than *to do*.
4. The confused professional identity that engineering has as a career.
5. The fact that our technology has grown so rapidly that the significance and impact of many of its accomplishments and problems are beyond the understanding of the layman. In particular, the fact that even among intellectuals technology and engineering are viewed with suspicion and as activities that lack deep intellectual content.
6. The fact that the ability of our society to diffuse the results of advances in science and technology is outpaced by the rising expectations generated by such advances.

7. The tendency, in the popular mood, to associate technology with ecologic disruption and with war and to discount many of its beneficial effects.

B. Several of the previous factors can be greatly influenced by *actions* leading to a greater involvement of women in technology and to a view of technology as an activity of interest to women as well as to men. These actions should be aimed at:

1. Achieving better communication through:
   a. Commitment of women engineers—especially through the Society of Women Engineers—to reach and use the mass media.
   b. Person to person contacts.
   c. Preparation of units of work that introduce technological concepts into school curricula at all levels.
   d. Establishment of rotating appointments of women as engineers-in-residence at liberal arts colleges.

   In this context, it is important and urgent that the widely held view of technology and engineering as an activity of men and by men alone be eradicated through a concentrated effort aimed at reviewing the current image projected by books, advertisements, etc. and reviewing the opinions of parents, teachers and counselors, as well as the opinions of male engineers.
2. Encouraging the sense of social responsibility of the engineer—a responsibility that women, because of their sensitivity as women, can most effectively perceive and strive to attain.
3. Supporting measures aimed at intensifying the professional nature of engineering and at reducing the confusion as to what engineering is. This should include legislation about the proper use of the title of "engineer."
4. Achieving a determined, informed and purposeful involvement of women engineers in government activities at all levels.
5. Employing the professional talent of women engineers for the development of innovative technological solutions that can alter the traditional work pattern of engineers and ease the burdens placed on many women engineers in their role as mothers and heads of households.

II. Resolution: Recommended*

A. Every participant in the conference commit herself or himself to write an article or prepare a visual presentation or other means of communication on one of the topics discussed at this conference and send a copy to the conference Steering Committee.**

*Resolution passed by the Conference.

**The Conference has been essentially successful in achieving this goal. Some of the activities resulting from this resolution are reported in the post-Conference *Newsletter* in Appendix A.

A More Detailed Account of Workshop I

The workshop conclusions and the resolution were the result of an intense set of discussions in which the problems of the gap between technology and society and of the possible role of women engineers were discussed candidly and vehemently, as shown in the following set of telegraphic-style notes. Inevitably, as in any group discussion, there are reiterations, *idées fixes*, disagreements, blind spots. But the notes, which are purposely left unedited, will hopefully convey the flair of the workshop, the mood, feelings, frustrations and concerns of the women and men participants. They will also provide a record of several intriguing ideas that unfortunately could not be pursued further during the workshop for lack of time.

Session I

Chairman: George Bugliarello
Recorder: Lois Greenfield

I. What factors perpetuate gap? What can we suggest to counteract this? Junior high school curriculum channels women into home economics, men into mechanical drawing.

II. The attitudes of society are important. The family gives girls dolls to play with, boys get erector sets.

Within society important considerations include environment, social attitudes, mass media, toys, erroneous ideas of masculinity, discrimination by males in profession, as well as the economic situation (men feeling women are a threat to their job).

III. Factors in society and technology gap

1. Lack of mathematics contributes to lack of understanding.
2. Decision processes—how they are made in technology, or what are the nuts and bolts of technology?
3. Force (encourage) industry to advertise this aspect.
4. Ask engineers to tell about this aspect.
5. The speed of technical advancement has snowed people. They are now blaming technology.
6. Hopes are built up—as in the accomplishments of the space program. This makes people feel anything is possible.

IV. Media give distorted picture of the facts.

How can we reach the media?

Advertising media are aimed at children, and are treating people as ignorant.

The antidote is personal contact.

It was suggested that you can always pull the plug on the computer. You destroy myths by personal contact. The younger generation may not believe in these myths.

V. The Image of Engineering

You might give a course to journalists on what technology really is—as at Texas.

You could have seminars for people in media—to explain about technology.

Science reporters should be informed.

Should engineers and scientists go for double degree in engineering and writing?

Difference between people causes gap, i.e., verbal or numerical understanding.

A difference between our society and USSR is that profit is not required in USSR.

Are there any engineers in Congress?

Colleges are concerned too little with basic understanding of real world. Engineering should put in its input.

The unemployment of engineers may help this, with engineers taking jobs in schools. (Engineering doesn't have a professional identity. The engineering role is confused—as garbage pickup.)

People blame engineers for being aloof from their profession. The conditions of work are complex. Engineers don't work directly with their public.

Engineers are poor communicators.

The public doesn't know what engineers are. They are confused by various other categories who are called engineers.

Engineers don't tell their wives what they do.

The present public reaction is against all technology, not engineers alone.

How many points did we get from showing space program on TV?

In the magazine *St. Nicholas* there are articles on "Men Who Do Things." Maybe *Life* could do this with articles on "Women Who Do Things."

Have we told them how much fun we have? We don't get the idea to people that engineers are human.

What do we say in response to the question, "What do engineers do?"

We don't paint interesting pictures: Bioengineering is, for instance, very attractive but we don't publicize it attractively.

Engineers build tools. Man uses tools.

The relevancy to society is important to youngsters. Have to show them where they fit into the big picture. (This is a problem for the engineering students we do get.) Must start with things they know.

How many engineers are willing to do this? We must be doing it, not expecting others to do it. Must start *already*. That's important.

The need for communication is important.

Do we need to cross pollinate writers and engineers? (difference between need and demand) (Problem of journalists not going to journalism school)

VI. What new ideas do we have?

1. Education of children (family attitudes, curricula, environment, counseling).
2. Mass media—education of journalists.
3. Speed of technology and level of expectations.
4. Philosophical shift from "doing" to "being" orientation.
5. Different motivation—profit vs. other.

How can you explain to the housewife the ramifications of power production?

VII. Possible Solutions

1. Communication
   a. Person to person.
   b. Journalists—give engineers course in journalism—too many engineers don't know what the public wants.
   c. Engineers must learn to communicate. They can't expect someone else to do this. Why can't engineering schools do this?
2. Education
3. Political action—we must change things that lead to this state of affairs—perhaps through legislation.

   Legislation
   a. About education (not a state responsibility).

b. Too much to expect uniformity.
c. No discrimination between human beings.
d. More emphasis on ethical practice of engineering (responsible for end product).
e. Engineering has been taught amorally.
f. Have engineers work more in public interest—as pressure groups for community service.
g. More participation in community. Make profit motive work, as make it profitable to be clean.

SWE* in the Bay Area have undertaken responsibility for educating women and girls in "This Is What I Do" (personal contact).

Look at the influence of one man, Ralph Nader. Nader's message—look what's happening to you instead of look what I do. This message is important.

American Academy of Science holds lectures—kids interested, attend Saturdays.

Consider the Ford safety campaign re the airbag. The objective is to inform the public with advertising.

Companies can do a lot to inform public. How can we get this to be for public consumption?

Can we establish clear goals that are reachable?

The influence of parents on career decisions is important. Mothers need to know what engineers do.

The basic family group should be educated. Engineers can turn people off—so need caution.

With the complexity of society, we don't know how to teach things.

For example, could we construct and operate a hospital for reasonable cost? Or re political problems—interstate compacts require 7 years. Could we find out how to do this in less time?

What feasible projects could we do? How can we reach people? How many? What community service can we recommend? Should we recommend education of journalists?

We must be realistic in our time estimates, and identify what's possible realistically.

Why not have a series of films (free use of theaters) with quality items on the fields of engineering, or at home on TV?

The problems with this approach are:

1. Getting money.
2. Obsolete soon.
3. TV education can be shown at any time.

Our society has achieved by means of prototypes. Cultural gap exists because of publicity. Can we show individuals doing their thing?

Truth in advertising.

Not just the image of engineering—it is the philosophy as well. Not just for engineers, also technicians. Engineering is not seen in its true light by the public.

We need the value of definite goal which we can tackle. We need a definition of what engineers do (written by engineers for engineers). We need a simplified explanation, written up as a guidance tool.

Who is society? What are we trying to tell people? Unless the world can understand and use technology to best advantage of man, we've failed. Children are going to know about science. What happens to them by the time they're ready to go to college. Education bores them. People with different concerns can't communicate with each other. Teach them "It's Their Thing." We need to know how to communicate at the appropriate level, at sensory level.

*Society of Women Engineers

Session 2

(Note: Roman numerals refer to persons speaking; repeated numerals do not correspond.)

In this section the Chairman asked each one to describe some specific project to propose to the group—"to bridge the gap."

I. Communication
3-level communication plan
1. Each one reach one.
2. Women engineers make themselves available for talks to non-professional groups.
3. Technical society publications should be oriented to social concerns. Should also give attention to informing mass media to help public understand what's going on.

II.
Use committee of EJC[1] to provide material for such contacts.

III.
Have to work with book publishers re image they give children. To make things more relevant to world of today regarding engineering problems. To make clear the woman's role in our changing world.

IV.
We must consider things which give engineers a good image. Bring family and friends into plant—hold an open house. Make it more interesting and fun. Bring mommy and daddy into school to tell what they do and why they enjoy it. Open offices to youngsters (including your own family).
Essay contests.
Orientation for wives—teas.
Pussycats on the go—showing new places and things on Saturday morning TV.

V.
Communications—most engineers can't write. Hold an Engineering Foundation conference on the preparation of written materials (TV or sample speeches) to help tell the story well.

VI.
SWE should perhaps try to place as many women as possible on faculty of different departments of schools. Also, engineers must display a willingness to communicate with their wives.

VII.
Education is important. Perhaps contact EJC[1] members to make materials more available. Develop visual aids to use in community to bring to young people.

VIII.
Since radio stations are required to devote time to public service, give them materials to present re women in engineering. Magazine section of Sunday paper might include relevant articles.

IX.
ASEE[2] could add emphasis on writing for non-technology laymen to engineering curricula. Might suggest a series of assignments in Freshman English

[1]Engineers' Joint Council.

[2]American Society for Engineering Education.

for scientists and engineers, or Professional Orientation in which students are required to explain a technical project to laymen which would be graded by laymen. We must emphasize clarity in non-technical writing.

X.

1. Courses should be in communication, not in technical writing. There is a failure on our part to communicate. The spoken word is important.

2. Should teach engineers more of social responsibility for their work. Employee should have some outlet for complaints about employer. Perhaps an Ombudsman setup on the federal level. We need the wherewithal for social responsibility.

XI.

Reach students through mathematics and science teachers at junior high school level.

Engineers and women engineers should be available, as for example at PTA meetings. We should include the organizations parents belong to, as in the lower grades where mothers come in, to change attitudes.

Write articles for widely read magazines about engineering and the role women can play.

SWE could invite parents and children as guests.

Science fair—scholarship or award to women participants.

XII.

Encourage legislation to prohibit use of title engineer except for *real* professional engineers. We should professionalize ourselves.

XIII.

Education. Over long range need to consider ways to upgrade elementary and high school teachers. Erase ignorance factor between careers. This could be a joint engineering and education project to change curriculum.

XIV.

Join human race—each one get involved where you fit best—local, township, church, school board. Do get involved.

XV.

Education. Try to influence, even if not easily done. Develop a unit of work and have it introduced to schools at different levels through state departments of education, through NEA, etc.

XVI.

Communication with the people who get word from us. That human life doesn't matter is the interpretation youngsters get. We need personal commitment that shows you care about youngsters as people, and then as an individual.

XVII.

One element missing—most projects require a budget.

Can get out as individual and talk to various audiences. Association for Computer Machines has voluntary speakers (lecture) bureau. SWE could do this. People have to work to learn to talk to particular audiences. Get examples that meet the minds of the people you're talking to. As, tell them man can pull the plug on computer if necessary.

XVIII.

Liberal arts colleges are a good place to try to reach. Colleges might bring in speakers for orientation type program (there is a problem of funds, however).

Perhaps develop an internship program—several hours per week working with someone where their interest is. Example of advertising you can do—Women's Bureau pamphlets.

XIX.

This is the profession's concern and business' concern. Possibility of professionals working with industry to attack communication gap. Work together to attack it.

XX.

Education—teaching engineering concepts to increase technological literacy among arts and science and pre-college students.

XXI.

New York section of SWE held a students night, with students and their parents and friends invited. Free dinner and program. To promote interest, write to schools and get names of students. University of Tennessee student chapter sponsors a sub-student chapter of ACM at the high school level.

XXII.

Hold a seminar for newspapermen.

We have a problem of ideology. Society doesn't really understand what technology is. Technology has not demonstrated its intellectual place in the university.

1. Goal—establish 10 professorships of engineering and philosophy or design training for it—to teach interface between technology and society.
2. For ideology, we need intellectuals and also activists to diffuse ideas.

Engineering would have much going for it.

Demonstration teams would be an active approach.

Volunteers for *good use* of technology.

If every participant would commit herself to do something for the communication problem, it would make a significant impact.

Discussion

I.

We can't reach people at the university level, it must be community.

We need some central clearinghouse to assemble materials, as Joint Engineers' Council.

II.

Talks on technology in general—women may have an advantage.

III.

We need a mechanism for outlet for complaints about companies' practices that discriminate against women engineers.

IV.

Could this be done through professional societies? The engineer is both employer and employee.

V.

Nader has proposed such a setup.

VI.

A government agency is not a good idea. It would be better to do this through the professional society.

VII.

Professional engineer registration includes ethics committee. We could bring in complaints by engineers. Can find out informally through professional societies who, or which company, is behaving amorally.

VIII.

An example of amoral behavior is pre-pension plan—layoffs.

Summary

1. Communication—professional societies, individuals, conference teaching.
2. Communication must be total involvement, must be concerned with communicatee.
3. Social responsibility—attempt to generate mechanism for—ethnics committees.
4. Professionalism—need for concept.
5. Intellectual—make technology fuller part of our society.
6. Combine all these as action mechanism—clearinghouse.

Workshop II

Women as Engineers

Chairman: Elaine Pitts
Co-Chairman: John B. Parrish
Recorder: Meredith Moorehead

Participants:

Julia T. Apter	Madonna Hardie
Andrew A. Arentz, Jr.	Alfred C. Ingersoll
H.G. Arthur	Meredith Moorhead
Paul E. Bartlett	Nancy L. Nihan
Despina K. Boinodiris	Mary G. Ross
L.D. Chipman	Herbert E. Sheldon
Nancy Fitzroy	Robert W. Smith
Donna C. Frohreich	Patricia A. Zeman
Joseph L. Grier	Mary Ann Zimmerman

Workshop II, just as Workshop I, also provided background for the program-action workshops by considering the outlook for women as engineers in terms of negative and positive economic factors, opportunities, changing attitudes and contributions of women.

I. Negative Factors
   A. Current unemployment of Professionals.
   B. Top management has changed but this is not generally reflected yet down the line among supervisors and recruiters.
   C. Lack of knowledge of "new" engineering opportunities.
   D. Financial crunch—universities and industry.

II. Positive Factors
   A. Engineering "New Look."
   B. Evidence of positive action in industry, government and universities.
   C. Increased interest among high schools and women entering colleges.
   D. Growing public awareness that environmental and social problems need the contributions of engineering and science.
   E. Many old myths about women in engineering are disappearing.
   F. Women will need to break away from traditional concentration in teaching.

III. Balance
   Favorable factors outweigh unfavorable.

IV. Conclusion
   "The Time Is Now"—for women in engineering.

V. Recommended Resolution*—"Bridging the Literature Gap"
   Inasmuch as it is the considered judgment of this Conference that talented young women in secondary schools or beginning study in higher

*Resolution passed by the Conference.

institutions should give serious consideration to engineering as a career field, and,

Inasmuch as there does not now exist any single, in-depth volume that provides insight into the careers of women as engineers,

Be it resolved that this Conference recommends the development of such a volume and will provide all possible support to that end.**

Be it further resolved that one or more individuals be named by the Co-Chairmen to explore the possibilities of developing said volume through a "Workshop—Career Writing Conference for Women Engineers."** The objective of this conference would be to bring together outstanding women engineers from all the engineering specialities in industry, government and academia and provide them with the time and the means for each to dictate a detailed individual report on such career aspects as:

1. How they became interested in and learned about engineering.
2. What problems were faced in obtaining an engineering education?
3. How did they obtain their first jobs?
4. What specific on-the-job tasks do they perform currently?
5. What have been the major satisfactions in engineering work?
6. What have been the major disappointments?
7. How have they accommodated to work in organizations dominated largely by men?
8. Has the latter fact been a cause for discrimination or difficulty?
9. How have they combined career and family responsibilities?
10. What are the problems involved in taking time out for child-raising . . . . how difficult is the return to career?
11. What particular qualities do women need if they choose engineering as a career?
12. What opportunities for advancement exist for women in the profession?
13. Would they recommend engineering as a career for young women now exploring career options, and if so, why?

**Editor's Note: As of the date of going to press, Professor Parrish had made considerable progress on this project.

Workshop III

A Program for Effective Participation of Women in Engineering and Other Technological Activities in Industry

Chairman: Grace M. Hopper
Recorder: Mary G. Sohler

Participants:

John D. Alden	Ruth A. King
Andrew A. Arentz, Jr.	Marion Monet
Betty Lou Bailey	Mary Ross
Despina Boinodiris	H.E. Sheldon
L.D. Chipman	Robert W. Smith
Nancy Fitzroy	Mary G. Sohler

Workshop III was devoted to considering five areas of employment practices in order to ascertain current and changing practices in industry and to make recommendations for bringing about the effective participation of women engineers in industry. The five areas were as follows:

1. Problems inherent in recruiting, hiring and on the job training.
2. Placement of persons and periodic review of placement.
3. Career development, management training and availability of classes for professional advancement.
4. Advancement opportunities.
5. Special problems, such as part time work, attendance at seminars and conventions, and membership in professional societies.

I. Summary of Conclusions

A. Regarding recruiting policies and procedures:

1. Untrained personnel are not recruited but are hired "off the street."
2. Technicians are recruited at technical high schools and junior colleges. The number of technical high schools is decreasing quite rapidly, but junior colleges and community colleges are increasing and providing the technologists and/or technicians.
3. The credit given to, or based upon, military service experience varies depending upon the classification of service school attended and subsequent working experience while in service. Recruiters do have available information about service schools; but since the schools are not accredited, no precise value can be placed upon the proficiency of the graduates.
4. Large companies send recruiting teams to all colleges and universities —small as well as large, women's colleges as well as men's. At the present time, some companies do include women on the recruiting teams; more companies will when qualified women can be found to fill the positions.

B. Regarding hiring policies and related topics:

1. Hiring procedures vary greatly. In some companies the personnel department does the interviewing; in others, the unit or section

supervisor or department manager interviews the prospective employee.

2. Many companies employing both husband and wife will transfer both at the same time. This information should be made known to young women graduates by recruiters or the personnel department.
3. There is available a nation-wide placement bureau, the GRAD system, which individuals may join and companies may contact for needed employees.

C. Regarding placement:
   1. Companies, especially the larger ones, are attempting to place women in positions where opportunities for advancement *are* available. However, there are still pockets of prejudice in *all* companies. This was agreed upon by all in the workshop.

D. Regarding job training, management and advancement opportunities:
   1. In many companies, advancement and training problems are common to both men and women. Sometimes, when given the opportunity to advance to management through training courses, women choose to remain on a non-management level. Advancement to management must be actively pursued through the expenditure of time and effort.
   2. Attitudes toward women in management vary within a company from one management level to another. Individuals on the upper levels know that women *must* be placed in management positions and seek to do so. The major problem lies with prejudice at the lower levels. There is no one clear-cut solution to this problem which must be solved by each individual company through education of the lower eschelon supervisors.
   3. Though government demands that industry advance women in management, there are not enough qualified women who are willing or desiring to advance to management.
   4. Intership programs which lead to rapid advancement in many companies include women, but many times such a program, which may include temporary relocation, is difficult if not impossible for a married woman with a family. Therefore, she must choose between family and professional advancement to management.
   5. Pregnancy leaves and working regulations are becoming more flexible, and managment is learning to adjust to such absences. Positions are either kept open or similar positions are available when women return from pregnancy leaves.

E. Regarding special topics:
   1. Women who are unable to work full time because of family responsibilities can do engineering of certain types in the home, e.g. consulting work.
   2. Occasionally a company will allow flexible working hours—for instance, a 30 hour week instead of the 40 hour.
   3. Women with common engineering backgrounds and who are unable to work full time can and do form into groups for working purposes. By joint effort, full work assignments can be accomplished. The types of work performed by such joint effort must be those which can be done away from the plant or company, e.g. programming, consulting, research, etc. One such group of 30 programmers in the Boston area has formed a very successful organization.
   4. During times of full employment, many companies will employ part time workers.
   5. Companies more readily send men rather than women to conven-

tions, seminars, etc.; though at the present time, attendance is declining because of the economic situation.

II. Recommendations

A. Companies should be advised and encouraged to:

1. Inform students of the hiring policies and personnel practices of the company.
2. Hire husband and wife teams.
3. Work toward removing all pockets of prejudice at all levels.
4. Consider pregnancy as a temporary disability and retain positions for the returning employee.
5. Appoint an ombudsman or someone in an equivalent position to handle those personnel problems which must be solved by someone other than the immediate supervisor.
6. Print and make available to employees personnel policies.
7. Establish day care centers for the children of working employees.
8. Give part time employment to available workers.
9. Even during times of economic depression or recession, send employees to seminars, conventions, etc., in order to disseminate and/or receive information concerning new developments and ideas.
10. Have specifically trained personnel management people who are knowledgeable about the corporate personnel policies.

B. Women who are discriminated against should be urged to take corrective action, first on an in-plant level, or if this procedure is not effective, on a higher level through government channels.

Workshop IV

A Program for Effective Participation of Women Engineers in Government

Chairman: Arminta J. Harness
Recorder: Patricia Anne Zeman

Participants:

Harold G. Arthur	Catherine H. Proctor
C. Anne Bennetch	Irene W. Sharpe
Barbara G. Fox	Renne R. Stone
Jacqueline G. Gutwillig	Patricia A. Zeman
Madonna Hardie	Mary Ann Zimmerman
Bette A. Krenzer	

Workshop IV outlined some of the key problems concerning women engineers in government and suggested solutions that would be effective throughout the system.

I. General Comments on the Workshop
   A. The primary value of this workshop was increased understanding on the part of each member concerning the multitude of differences that exist in employment practices among the various agencies of government, and therefore the difficulty of proposing single solutions to common problems. It was discovered, among other things, that no two agencies have exactly the same procedures or methods for implementation of broad "top level" guidelines. This is true even within various departments of the same agency. There is not one identically administered Federal Civil Service System. This fact, more than any other, influenced workshop discussions. Therefore a serious attempt was made to identify general problems and recommend actions that would be applicable to any agency.
   B. Because the members frequently found lack of knowledge hampered discussion, other Conference attendees who were considered experts and some of the guest speakers were invited into the workshop to "testify." This was of significant assistance, but unfortunately such experts could not always be continuously present during the entire Conference.

II. The Problems Considered by This Workshop
   A. Attracting more women into government
      1. This problem is not limited to women—all student engineers are reluctant to enter government when industry is hiring. This is better than in the past. Young engineers now receive comparable or better starting salaries than in industry, *in the Federal agencies.* States are still below industry and cities and counties are in between.
      2. There are problems in attracting new engineers when we RIF* older ones. Long time planning, however, requires "new blood" to be brought in at regular intervals.

*Reduction in Force

3. The best method of attracting new graduates is to have attracted them earlier; i.e., through student trainee and summer hire programs and through co-op programs with colleges and universities. Both programs, however, require good supervision and interesting jobs. Prospective employees can be "turned off" as well as on.
4. The Federal recruiting program is not satisfactory. There seems to be no long-range plan and salesmanship is poor. The entire program needs updating. The Dictionary of Occupational Titles used in recruiting (primarily by non-Federal agencies) is badly out of date. Updating action by the Department of Labor is recommended.

B. Increasing opportunities for women already in government.
1. It was generally agreed that the recent (May 1971) Presidential Order to Federal Agencies which requires them to look within their agencies to promote women and to insure equal recruitment of women may eliminate many of the discriminatory practices now found (both overt and covert) in *Federal* agencies. The Order is too recent, however, to fully judge its effectiveness. Only passage of the Equal Rights Amendment will solve the problem for *all* agencies—Federal and non-Federal.
2. Many government personnel, particularly in the middle management areas, take a "don't rock the boat" attitude toward equal opportunity problems of women employees. Too many women also take this attitude and don't even try for advancement.
3. Veteran's preference rules generally work to the disadvantage of women (because more men than women are veterans) but such rules are National policy and are "sacred cows."
4. Information concerning the Equal Employment Opportunity program (Federal) is not widely disseminated. Even the Coordinator has a hard time receiving information. The newness of the program may be the reason for this. Tracking action by the Federal Civil Service Commission is recommended.
5. It was generally agreed that women must let management know that they are interested in advancement and must look into all opportunities themselves. "If she doesn't care enough to push her own career, she doesn't deserve a promotion."
6. The manner in which the Merit Promotion Program is implemented is sometimes less than fair, but competition is tough and women have to be prepared to compete.
7. Academic and management training programs are available in some form, varying from formal programs with participants identified by the agency to programs dependent upon the individual employee's initiative. Training is generally available to women, although:
   a. Supervisory training has been denied to women engineers and scientists in the city government agencies represented.
   b. Training programs requiring field activity are frequently denied on the basis of rough terrain, bad language, etc.—more in Federal than City Government.

   It was agreed, however, that the sample size of this group was too small, with too narrow a scope, to really determine if women are generally discriminated against in this area. This problem would also be resolved by passage of the Equal Rights Amendment.
8. Top management needs feed-back on problems; i.e., raise a fuss if discriminated against. First line supervisors will resent this action however.

9. One way to overcome discrimination is for women to gain the respect of contractor personnel with whom they work. This will feed back to their own management personnel.
10. Being a trail-blazer makes it easier for the next person but doesn't gain much for yourself.
11. Firm direction is needed from the top, with specific instructions /directives on what *can not* be denied to women, Although various Orders, Amendments, etc. now cover these in general terms, an easy to read list of "cannots," such as "cannot deny employment because of required shift work, travel, etc.," is needed for working level personnel.
12. Management needs an open door policy on complaints and grievances. Some agencies have responsive grievance procedures while in other agencies, processing a grievance may take two years.
13. Most government personnel departments serve neither management nor the employee. If an employee receives an unsatisfactory answer from personnel, the employee should go up the supervisory chain to confirm or refute the information.
14. The Federal Women's Coordinators should be responsible for informing women employees of their rights, as well as acting on grievance matters. Whether or not they can properly do this depends on the number of women they serve as well as their position. Some agencies have F.W.O.'s in high level positions full time and others at low grade levels and serving part time. More specific direction is needed concerning the criteria for implementing the Federal Women's Coordinator Program.
15. Provision for part time employment (less than eight hours per day and possibly less than five days per week) in various government agencies would be highly desirable. Such employment:
    a. could not apply to all agencies because of special work requirements but would be ideally adapted to computer operations and laboratory test activity.
    b. could only offer limited career advancement.
    c. would be ideal for present full-time employees who would like to start a family, as well as for the engineer who wants to return to the work force after raising a family.
    d. would require changes in manpower position ceilings and/or policies. Management would not give up a full-time position for a half-time position but might accept two half time employees against one position. Such a federal program is now possible, as temporary employment, but is not widely implemented. (A study of this problem in depth at all levels of government would be highly desirable but would be quite costly and difficult to implement.)

C. The role of the woman engineer in making her government agency more responsive to social needs.
    1. Each engineer in government should become involved in community activity—lending technical knowledge and advice on community projects such as highway projects, new sewer systems, etc.
    2. Engineers, particularly women engineers, need to make a personal commitment to inform the community of how technology is relevant to the needs of society.
    3. Engineers must reaffirm their moral responsibility to ensure that proper regard for the safety, health and welfare of the public be given full consideration in the solution of technical problems.

III. Recommended Resolutions:*

A. Be it resolved that this Conference endorse the proposed Equal Rights Amendment to the United States Constitution, which would provide that "Equality of rights under the law shall not be denied or abridged by the United States or by any State on account of sex," and that individual engineers be urged to express their support to their Congressional delegation.

B. Be it resolved that women engineers make a personal commitment to inform the community of how technology is relevant to the needs of society.

C. Be it resolved that Federal and non-Federal Civil Service Commissions facilitate part time employment in Government.

D. Be it resolved that women engineers be encouraged to provide feed back of their problem to top management when necessary for solution.

*Resolutions passed by the Conference.

Workshop V

A Program for
Increasing the Effective Participation
of Women Engineers in Education

Chairman: Alfred C. Ingersoll
Co-Chairman: Julia T. Apter
Recorders: E. Booy, D. Frohreich, L. Greenfield, N. Nihan and B. Pollak

Participants:

Emmy Booy	Meredith Moorhead
Amogene F. DeVaney	Nancy L. Nihan
Donna C. Frohreich	John B. Parrish
Lois B. Greenfield	Betty L. Pollak
Joseph L. Grier	Caroline Preece

Worshop V addressed itself to five main problem areas. Extensive and encompassing recommendations for programs and action that would greatly increase the effective participation of women in engineering in education were made, together with suggestions for means of implementation. The five areas considered were:

1. The employment of women in engineering faculties.
2. The promotion of women faculty members.
3. The presence of women in policy-making positions in universities.
4. The effect of the misleading image of women in engineering.
5. The low enrollment of women as engineering students.

Problem Area 1: Insufficient Number of Women Hired for Engineering Faculties

Recommendation:

1. Create part-time faculty positions on tenure track, requiring teaching, research and service with proportional salary and tenure credit, e.g. 10 years at half-time for half pay would yield five years credit toward tenure.
2. Place qualified women on committees responsible for new appointments. If properly qualified women are unavailable from within the pertinent academic unit, obtain them from related disciplines or institutions.
3. Whenever a faculty position is open, the appointment committee will, before the position is filled, investigate qualified women and ensure that they receive full consideration.
4. Professional societies appoint qualified women to panels available for ECPD (Engineers' Council for Professional Development) accreditation visits. Chairmen of ECPD accreditation visits include on their teams women from these panels.
5. Professional societies nominate and/or appoint qualified women to the Education and Accreditation Committees.
6. All accreditation visiting teams ask direct questions regarding status and participation of women on the faculty.

7. Society of Women Engineers join ECPD.
8. Eliminate nepotism rules as applied to engineering faculties and present to all applicants and candidates written evidence that nepotism is not a consideration at that institution.
9. Present to all applicants and candidates a written statement that women are considered on the basis of qualifications alone and there is a single salary scale and equal opportunity for advancement for all faculty.

Means of Implementation:

A. Publish annually an updated list of engineering schools having women faculty. List names and departments of women faculty and number of women students in the school or college.
B. Prepare article for *Journal of Engineering Education* (American Society for Engineering Education) illustrating influence of women faculty on recruitment and retention of engineering students.
C. Distribute the foregoing list and article to all deans of engineering and their provosts and presidents.

Problem Area II: Inadequate Promotion of Women Faculty to Advanced Ranks

Recommendations:

1. Promotion review committees include qualified women. Where qualified are unavailable from within the pertinent academic unit, obtain them from related disciplines or institutions.
2. Review status of all women faculty now in engineering schools to assure equity in salary and promotional opportunity.
3. Review activities of all women faculty in engineering schools to assure equity with respect to teaching, service and research and opportunities to gain experience in such activities toward promotion and tenure.

Problem Area III: Insufficient Number of Women Faculty in Policy-Making Positions

Recommendations:

1. Place qualified women at all faculty (and student) levels on search and screen committees.
2. Distribute a flyer including a list of people on the search committee, designating the chairman, describing the needs of the institution with respect to the position open and calling for unsigned nominations.

Problem Area IV: Generally Misleading Image of Women in Engineering

Recommendations:

1. Women engineers and college administrators be aware of the danger that isolated women on engineering faculties, while giving the outward appearance of an open policy toward women, may in fact be evidence of restricted opportunities for women.
2. Professional societies nominate or appoint women to all professionally oriented committees of ECPD.

Means of Implementation:

A. Write to Cattell Press to change title of "American Men of Science," to "Directory of American Scientists."

Problem Area V: Low Enrollment of Women in Engineering Schools

Recommendations:

1. The conference group authorize distribution of the attached recommendation to all deans of engineering.

*Recommended Resolution on Women Faculty in Engineering Schools:**

Whereas the employment of women engineering faculty members is the clearest indication of a positive institutional policy toward women in engineering, and

Whereas it has been demonstrated that women engineering faculty have a positive influence on the recruitment and retention of engineering students, especially women students, and

Whereas many qualified women are overlooked for possible appointment to engineering faculty or administrative positions or, once appointed, are too often restricted in promotional opportunities,

Now therefore be it resolved that this Conference urge all engineering schools to give full consideration to the appointment of women to faculty positions, based on qualifications alone, with single salary scale and equal opportunity for advancement and specifically rejecting any consideration of nepotism.

Be if further resolved that all appointment, promotion, accreditation, search and screen committees include qualified women and, if none is available within the pertinent academic unit, that they be obtained from related disciplines or institutions.

Be it still further resolved that part-time faculty positions be created on tenure track, requiring teaching, research and service, with proportional salary and tenure credit.

*Recommended Resolution on Enrollment of Women in Engineering Schools:**

Whereas the enrollment of women students in engineering schools has increased over the last ten years, but is still far below an acceptable level,

Be it resolved that the Steering Committee of this conference authorize and encourage distribution of the attached specific recommendations evolved at this Conference to all deans of engineering schools for implementing a program for recruiting and retaining women students in engineering programs.

Be it further resolved that this conference encourage the Society of Women Engineers to make annual mailings requesting from all deans information about the effectiveness of their efforts to implement these recommendations, and to provide accurate enrollment and degrees-granted statistics by sex.

*Resolutions passed by the Conference.

Recommendations for Increasing the Number of Women Engineering Students

A. Appoint a Coordinator

Appoint someone to the faculty of the School of Engineering to coordinate recruiting and retention efforts aimed at women students in engineering.

Such a person should be:

1. Interested in encouraging women to enter engineering and in providing attractive role models.
2. Preferably a woman faculty member or other woman attached to the engineering school, e.g. academic advisor, assistant dean, or administrative assistant (not a secretary), if a faculty member cannot yet be found.

These responsibilities should comprise a significant proportion of this person's work-load.

Necessary money should be allocated for recruitment and retention activities.

B. Remove Restrictions

1. Revise all admissions policies to eliminate discrimination against the admission of women students into the school of engineering.
2. Review financial aid policies to see that women engineering students are given equal consideration for available financial aid.

C. Establish Scholarships

Seek additional funds to establish scholarship, grant, and loan support for women students majoring in engineering.

D. Provide Engineering Experience

Provide opportunities for women students to gain experience in engineering-related jobs:

1. Increase opportunities in cooperative programs.
2. Provide on-campus jobs related to engineering.
3. Establish summer job programs for women.

E. Publicize Opportunities

Publicize opportunities for women students in the field of engineering and state the college's willingness to enroll women students.

1. Publicity materials made very attractive and continually updated
   a. Pamphlets available from the Women's Bureau
   b. Pamphlets available from the S.W.E.
   c. Develop new materials dealing with your particular school
2. Include photographs of women students and faculty in engineering school catalogues and other publications.
3. Revise the college's published materials to use the words "he and she" when referring to engineering students.
4. Establish summer institutes on your campus to introduce high school girls to engineering and effective role models.

F. Identify Potential Women Students

Potential women students can be sought from at least four sources:

1. Students expressing interest in your college or university
   a. Women students who have already submitted applications to your college and who have *high math scores* on the SAT or ACT tests. (College admissions offices should have SAT or ACT scores available.)
   b. Women who have applied to your college and who state an *interest* in any of the following majors.

      Math, physics, chemistry, biology, geology, computer sciences, other physical sciences; math teaching, physical sciences teaching; pre-med

and pre-law; as well as engineering.

2. Students with necessary aptitude and/or interest (but who have *not* yet expressed an interest in applying to your college)
   a. High school girls who score high on the math portion of the National Merit Scholarship test.
   b. High school girls who indicate an *interest* in engineering, math, or the physical sciences when they take the National Merit Scholarship tests.
   c. High school girls recommended as having outstanding records in math and science or having strong math-science interests. Such recommendations can be solicited from high school math and science teachers and counselors. (College admissions offices can supply mailing lists of high schools.)
   d. High school girls participating in state and local science fairs.
3. Women already enrolled in your college and who might be seeking a new major
   a. Math and physical sciences major
   b. Math and physical sciences *teaching* majors
   c. Undecided students
   d. Students recommended by the Dean of Women's Office
4. Transfer students from community or other colleges

G. Contact Potential Students

Send letters to prospective students encouraging them to apply to the school of engineering and providing information on engineering as a major subject and as a career.

Such letters might contain:

1. Names and addresses of currently enrolled women engineering students who would be willing to write to high school girls.
2. Names and addresses of women engineering faculty members willing to reply to students' inquiries.
3. Applications for engineering scholarships for women.

H. Plan Follow-up Activities

For high school girls who respond to this initial letter, various follow-up procedures could be employed:

1. When several girls reply from the same high school or the same city, plan a visit to the high school by engineering *students* and a faculty member (preferably female) to contact the girls personally.
2. Invite students to visit campus and offer to plan visits to classes and to arrange interview with engineering students and faculty members.
3. Send personal letters of reply to inquiries from women students.
4. For students living some distance from the university, ask engineering alumni to make personal contact with interested students.

I. Establish a Retention Program

Establish a counseling and retention program for women enrolled in the school of engineering.

1. Organize special orientation programs for women engineering students.
2. Sensitize all academic advisors dealing with women students to the special needs and potential problems of women students majoring in engineering.
3. Establish procedures for following the progress of all women engineering students throughout their college careers and beyond.
4. Make efforts to see that freshman women have an opportunity to know other freshmen and upper class women students in engineering.
5. Publish an annual directory of all undergraduate and graduate women engineering students and women engineering faculty members.

6. Make an active effort to educate your own engineering faculty and other engineering students to the acceptability and desirability of having women engineers.
7. Retain and call attention to effective female role models for the women students.

J. All institutions keep accurate statistics by sex on enrollment and degrees granted.

Workshop VI

Recapitulation: The Society-Technology Gap and Women in Engineering

Chairman: Andrew A. Arentz, Jr.
Recorder: Mary G. Sohler

Participants:

John D. Alden	Ruth A. King
Andrew A. Arentz, Jr.	Marion Monet
Betty Lou Bailey	Mary Ross
Despina Boinodiris	H. E. Sheldon
L. D. Chipman	Robert W. Smith
Nancy Fitzroy	Mary G. Sohler

After completing the tasks outlined for Workshop III, the members of that Workshop formed Workshop VI in order to pursue further some of the general issues concerning the gap between technology and society, the role of women engineers in bridging the gap and the opportunity for women to exercise their role.

I. The Questions
   A. Should there be more women in engineering? If so, why?
      1. Is the implication that women would be given more credence by other women in "explaining" technology?
      2. Is the implication that women are more sensitive to the needs of society and therefore, women engineers will be the leaders in "bridging" the gap?
   B. Assuming that there is not equal motivation for women to enter the technological fields e.g. engineering, what are the causes and what are the remedies?
      1. short term
      2. long term
   C. Assuming that there is not equal opportunity for women to enter the technological fields e.g. engineering, what are the causes and what are the remedies?
      1. short term
      2. long term
   D. Should women be included amongst the leaders in setting the priorities and goals of society or at least be major participants in the formulation thereof? If so
      1. How can women in technical fields help?
         Do they need numbers to do so?
         Do they need more status to do so?
      2. If the answer is yes, how do they do so?
      3. How can these women form a consensus about these goals?
   E. Assuming that the gap is an expression of a dissatisfaction with the quality of life with which technology has or has not provided society, can technology "bridge" the gap?
      1. with a large proportion of women in engineering ranks?

2. with a better understanding of the processes of technology by the women in society?

II. Summary of Discussion and Conclusions

A. Women Bridging the Gap

1. The generally believed fact that women have a greater sensitivity to the needs of society can be used to the benefit of all.
2. Women engineers can communicate with non-technically oriented women concerning the need for and problems of the products of technology. Then the greater the number of women who have some understanding of technology, the better these informed women become as citizens, as voters and as users of the products of technology.
3. The more women engineers there are to assist in the stimulating of interest in and basic knowledge of technology the greater the number of women who can be reached and informed.
4. Bringing women into the profession will "humanize" male engineers. Men and women engineers working together to "bridge the gap" and to inform the non-technically oriented can do more than either men or women alone.
5. Means of "bridging" the gap.
   a. TV programs
      A. Independent producers might be interested in special interest programs.
      B. There are now some channels specifically for educational programs and efforts are being made to have more so designated.
      C. Local school TV programs viewed in the classroom can be utilized to inform students.
   b. Advertisements
      A. Some companies already in their advertisements explain technological problems in terms which the average non-engineering person can easily understand. This is helping to "bridge" the gap. More companies should be encouraged to do likewise.
   c. Speaking to women's groups
      A. Women engineers should be encouraged to speak as often as possible to women's clubs etc. taking the opportunity to discuss and/or explain in non-technical terms some facet of technology of interest either locally or nationally.

B. Motivation

1. Motivation must begin at an early age.
2. A major problem is the lack of technological information given to teachers and female students in grades 6 through 10.
3. Women working in job levels below their capabilities need to be encouraged to take courses and to advance to higher levels of achievement—even to the engineering level.
4. Girls need to be encouraged to make serious career plans since most will be employed for many years. Those girls with aptitude and interest in math and science need to be encouraged to pursue the subjects and to enter the engineering field. Negative counseling must stop!
5. Means of motivating
   a. Courses and programs
      1. AIAA (American Industrial Arts Association) has very

helpful publications. However, since illustrations do not include women, SWE (Society of Women Engineers) should work with AIAA to incorporate women engineering information into the publications.

2. ECCP (Engineering Concept Curriculum Project) – The man Made World – is available from Brooklyn Polytechnic Institute.
3. SME (Society of Manufacturing Engineers) has an excellent course, but again women are not included in the illustrations. SWE needs to work with SME to correct the omission.

b. Scholarships are available and girls should be informed about them.
c. Since SWE represents all types of engineering, it is the logical organization to contact and work with qualified girls through Professional Guidance and Education programs.
d. Schools need to be encouraged to include girls in student group tours of engineering activities.
e. Engineering *per se* must be considered as the profession – not the individual types. This is most important!

C. Opportunity
1. There is not real discrimination against women *entering* the engineering profession.
2. In theory men and women have equal opportunities for advancement.
3. In actual practice, due to prejudice usually on the lower level of management, opportunites are not equal *as a rule*.
4. Conclusion: The engineering profession must be an "open" one; it cannot exist if certain people are excluded from entering or advancing in the profession. The "closed" profession could turn away both women and men who will not tolerate prejudice.

D. Setting the priorities and goals for society
1. Anyone with the interest and capability can and should help set priorities for society.
2. A professional person has a better chance of being a leader than an uneducated person has.
3. An engineering viewpoint is important; a management engineering viewpoint is not necessarily more significant.
4. Conclusion: Engineering societies fail to motivate their members to participate in the activities of society.

E. Can technology "bridge" the gap?
1. Engineers must take courses in the humanities. This is essential to "bridging" the gap! One group must understand the other–the humanists and the technologists.
2. Women have credibility with the public - especially since women make up 53 percent of the population at the present time.
3. Conclusion: Engineers should be encouraged to take courses in the humanities so as to develop an appreciation for and knowledge of the sociological aspects of society.

III. Recommended Resolutions:*

A. Engineering should be promoted as a profession without regard to the separate branches.

*Resolutions passed by the Conference.

B. Engineering should be known as an equal opportunity profession without discrimination.
C. The Society of Women Engineers should be encouraged to assist its members to understand women's legal rights.
D. Technology should be promoted as a subject for all to understand.
E. All engineers should encourage young women with aptitude and interest to consider entering the engineering profession.

Concluding Resolution

Proposed by David R. Reyes-Guerra and passed by the Conference:

Resolved that the Conference impanel the Steering Committee and the Workshop Leaders to present to the President of the United States, through his Science Adviser, Dr. E. E. David, the recommendations and resolutions of the Conference.

Conference Attendees

Alden, John D.	Executive Secretary Engineering Manpower Commission New York, New York 10017
Apter, Julia T.	Professor of Surgery Rush Medical College Chicago, Illinois 60612
Arentz, Andrew A., Jr.	General Manager, Research Division General American Transportation Corporation Niles, Illinois 60648
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Hopper, Grace M.	Head, Navy Programming Languages Section Department of the Navy Washington, D. C. 20350

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Leich, Harold H.	Chief, Policy Development Division U. S. Civil Service Commission Washington, D. C.
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Appendix A

A Post-Conference Newsletter

This *Newsletter* reports on the post-conference activities of the Henniker-71 participants, as well as other items of interest.

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Announcements

1. A follow-up conference is being planned for next summer at Henniker, July 16-23. Further information may be obtained from Al Ingersoll and/or Olive Salembier, co-directors.

2. The 1971 Conference *Preceedings* should be published and available by May. Herb Sheldon has been working diligently to raise the funds that will be needed for this effort, and we are most grateful to him.

3. *Mary Ann Zimmerman* was selected by the Illinois Society of Professional Engineers for a special recognition award in the Young Engineer of the Year contest. This was featured in an article in the Chicago Tribune as "A Young Woman Who Really Stops Chicago's Traffic." Congratulations Mary Ann.

News and Notes

In this issue, items gleaned from the responses to the follow-up questionnaire will be reported. No attempt has been made to be complete. (Especially since we failed to ask for names from our respondents.) Rather, our objective is to report some of the interesting things that are happening, are in the process of developing, or may be about to be future activities.

Your cooperation in this clearing house of ideas and information is requested. Send reports to Vivian Cardwell or Lois B. Greenfield.

John Alden plans to issue an Engineering Manpower Bulletin on the subject of Women in Engineering.

Betty Lou Bailey reports that she invited herself to be a member of the local ASME committee on career guidance. They plan an evening program on engineering for guidance counselors in the four county area. She plans to "get in a pitch on women."

Despina Boinodiris reported on the conference to IBM's higher management, but feels the report was taken "calmly." She will do her best, though, to keep the issues alive.

Emmy Booy is attempting to spread the word about engineering to high school girls, particularly at the economic extremes . . . "too rich to worry or too poor to believe the sterotyped images of women." She's trying to start a student SWE chapter at Michigan Tech. Both in and out of the classroom, Emmy is trying to convince engineering students of the relevance of humanities. She's also trying to inform fellow female faculty members about the existence of Affirmative Action Programs. Feels SWE should include synopses of new laws and court decisions affecting women in its newsletter.

L. D. Chapman reports continuation of equal rights activities, including placing more women in technical positions each year.

Amogene DeVaney disseminated information on women in engineering to girls enrolled in pre-engineering and science programs. In an attempt to bridge the gap, she planned an engineering design presentation which will be open to all students. She called attention to the fact that the female dean of students is not receiving compensation comparable to her rank.

Nancy Fitzroy helped plan a special session on Equal Opportunities at the ASME annual meeting in Washington, D.C. as a result of her activities with Working Party for goal 14 (equal opportunities). This group plans to promote a national program for counseling for minorities and women as high school sophomores, as well as college tutoring for these groups. She hopes that further conference activity will be directed toward improving the "lot" of women engineers already in industry, particularly those in small corporations.

Donna Frohreich has published a small pamphlet on Women in Engineering at Purdue, has initiated publication of a placement brochure to help women students find summer and permanent jobs, and plans to launch a recruiting campaign to increase enrollment of women in engineering at Purdue.

Lois Greenfield has distributed the Women's Bureau publication, "Why Not Be An Engineer?" to all juniors and senior high school guidance counselors in Wisconsin. She wrote "Women in Engineering Education" scheduled to appear in the February issue of *Contemporary Education*. Also helped develop a program presentation for the Wisconsin Personnel and Guidance Association on women in engineering.

Joe Grier has planned and developed a summer internship program for women engineers and physicists, and set specific goals for employment of women in '72—goals which are five times higher than '71 results.

Jackie Gutwillig, as chairman of the Citizens' Advisory Council on the Status of Women, reports that CACSW has developed and distributed a new paper on the Equal Rights Amendment, dealing with the potential effects of ERA on alimony and child support laws.

Madonna Hardie has participated in meetings of division heads and EEO officers in her role as Mid-Continent Region Federal Women's Program Coordinator for the U.S. Geological Survey. Reports that she's writing a column for the Topographic Division's monthly newsletter, "The Last Word," and has worked to make her group's youth summer aid programs more meaningful to the young women they employ.

Arminta Harness has publicized the conference in her organization newspaper, and through programs prepared and presented to Los Angeles chapters of Zonta International, SWE, and Lindenwood Alumnae Club. She states, "I think that a future Conference should address the subject of women engineers progressing into executive engineering and management positions, including information and discussions on the psychological and sociological aspects of management and the problems of continuing education and training."

Charles Horne has talked to technical societies and chambers of commerce on the value of women in engineering, and is encouraging career education as defined by Commissioner Sid Morland of Education, comments that "We still need to get the sociologists and techologists TOGETHER."

Al Ingersoll reports on the achievements of female engineers at UCLA i.e., student Ann Hoch is the first woman engineer president of the all school professional society; Diana Shows is the only student member of the Undergraduate Policy Committee of the School of Engineering and Applied Science. During Engineers Week, UCLA plans to host a tea for women students in high schools and community colleges. He requests ideas for topics and speakers at the 1972 conference on Women in Engineering to be held July 16-21 at Henniker. Olive has suggested the title "What you Always Wanted to Know About Women Engineers and Were Afraid to Ask."

Ruth King has written a memorandum for general reading within her company for technical personnel training and recruiting departments, which suggests some interim measures to open technological job opportunities to women through on-the-job training, and by means of summer jobs. In addition, she suggests that "...efforts should be directed toward setting up programs in the schools to develop engineers or engineering technologists from mathematics and science majors."

B. A. Krenzer, 1970 American Business Woman of the Year, has written an article for *Women in Business* on the Henniker Conference, and has talked to many groups, such as American Business Women's Association, student groups at University of Illinois. As a member of the Guidance Committee of the local Affiliated Technical Societies Council, has prepared a new package program for high schools to encourage *any* interested students to consider engineering. She suggests that Hennikerites should be encouraged "to get on speakers lists....It doesn't pay and the food isn't always too good but with a catchy title one can get lots of calls ...to women's groups—and they make ideal audiences for 'bridging the gap' material."

Harold L. Leich distributed his speech on "Opportunities for Women Engineers in the Federal Service" to all coordinators of the Women's Program in all Federal Departments and Agencies.

Marion Monet wrote a note to the Chairman of the Board about the lack of women at executive levels. She reports that a few months later a black women was named to a Board of Directors, and wonders whether her letter sensitized them to the need of a woman.

Nancy Nihan reports that she is interested in initiating program of research on recruitment similar to Betty Pollak's at Oklahoma. Also plans to study relation between data on women college students and women engineering students. Is

advisor to women engineering students' proposal to do a systems engineering study on housing problems in Chicago.

John Parrish has completed exploring the possibilities for financing the workshop on "what women engineers do" with various foundations. He's also exploring possibilities for support of a conference on "Bridging the Literature Gap."

David Reyes-Guerra continues to support programs that "encourage women to consider and understand engineering." He suggests that in the future, conferences include more people who directly influence the young, as 4H, Girl Scouts, etc. "Working with those who will be in the profession 10-15 years from now is extremely important."

Mary Ross has talked to several groups on women in engineering, and appeared on two TV interviews on the same topic. She's also participated in counseling sessions with junior and senior high school girls.

Irene Sharpe's baby girl, Jennifer Claudine, was born October 1. Irene decided to continue working, so she'll "be able to maintain more professional contacts with whom I can 'team-up' to accomplish some of our goals." She has continued her service on the Federal Women's Program Committee of the Denver Federal Executive Board and in the Association on Federal Professional and Administrative Women. As a result, "negative" form letters previously sent to women going on maternity leave will no longer be sent. Is also concerned with insurance coverage terminated because of job termination coincidental to pregnancy.

Herb Sheldon has written letters to engineering VP's of operating telephone companies on ways to augment numbers of female engineers. Helped develop an engineering assessment program designed to identify individuals (females in particular) with potential to work in entry level application engineering assignments. Also established engineering manpower action coordinators in the operating companies to implement programs.

Mary Sohler chaired a meeting of the Detroit section of SWE, reporting on the Henniker Conference and discussing "Women in Engineering—Bridging the Gap Between Technology and Society" with the section membership. Has tried to make individuals in her company aware of their responsibilities in giving women equal opportunities. Plans to work with local SWE in Engineers Week activities.

Robert Smith has developed a slide-narrative presentation aimed at secondary school students to interest them in engineering. Emphasis is on bridging the gap, and persuading women that engineering is a rewarding career. This will be submitted to the National Career Development Committee of ASM, for possible use by all chapters.

He feels that women members of all major technical societies should make their voices heard at this time, when the societies are reexamining their goals and moving away from their traditional technical and educational activities.

Winifred White is working hard as editor of the Proceedings of the Conference. One of the main facets of her job is to encourage girls in the study of engineering and to help women engineers in their professional progress.

Eileen Woods who did not attend the conference, but helped to plan it, reports that the Chicago section of SWE has joined the Illinois Engineering Council, in order to gain added professional backing in influencing legislation affecting women engineers.

The Chicago section of SWE held a symposium of female scientists and engineers to discuss "Women and their Engineering Power."

Pat Zeman has written several letters to influential persons on behalf of equal rights legislation.

Mary Ann Zimmerman has made contact with a group of New York engineers who publish a magazine, *SPARK*, devoted to increasing engineers' awareness of their social responsibilities. Has talked to a JETS club in a technical high school about women in engineering.

"Attended National Conference on OJT Programs for Disadvantaged Youth in paraprofessional positions in the engineering and achitectural fields. Hope to obtain a reasonable percentage of positions on the program developed in Chicago for women."

"Humanizing the engineer is a larger problem than just for women . . ."

The College of Engineering at the University of Illinois at Chicago Circle has joined with the Chicago Section of SWE in a joint effort to recruit more women from minority groups into engineering. The College was also able to add another woman to its faculty this year, increase its enrollment of women by 6 percent and double the number of its black women students.

Appendix B

*A Selected Bibliography**

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*Compiled by Vivian G. Cardwell, College of Engineering, University of Illinois at Chicago Circle and John B. Parrish, Department of Economics, College of Commerce and Business Administration, University of Illinois at Urbana-Champaign.

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